CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co., Inc. December 13, 1922 25 Cents Per Copy

ELLWOOD HENDRICK
Consulting Editor
ERNEST E. THUM
Associate Editor
ALAN G. WIKOFF
Industrial Editor
J. S. NEGRU
Managing Editor

CHEMICAL & METALLURGICAL ENGINEERING

A consolidation of
ELECTROCHEMICAL & METALLURGICAL INDUSTRY *and* IRON & STEEL MAGAZINE
H. C. PARMELEE, Editor

R. S. McBRIDE
SIDNEY D. KIRKPATRICK
A. E. BUCHANAN, JR.
GRAHAM L. MONTGOMERY
CHARLES WADSWORTH, 3D
CHARLES N. HULBURT
Assistant Editors

Volume 27 — New York, December 13, 1922 — Number 24

On the Merit of Being In Business for One's Health

"WE ARE NOT in business for our health," said a man of affairs, as he turned a mean trick and offended against his obligations.

Now this notion was his misfortune. The poor devil thought he was in business only for profit; he did not know that if a business establishment is operated solely for the profit of its owners, it cannot endure. It has a liability that does not show on the balance sheet. It may seem but a phantom, but it will soon take on shape and substance. A business concern is patronized in the measure that it satisfies the needs or wants of other persons than its owners. Its very life is in its fulfillment of its obligations to its customers, to the trade. The human demands upon a business organization are as great and insistent as those upon a household. The point is obvious, but many stockholders miss it.

If we succeed and are surrounded by men of good will toward us, we are doing more for our health than we can get out of all the watering places and health resorts in the country. It is fighting and quarreling, and worrying over the fear that we may lose out, that is the killing pace.

Imagine two men engaged in producing and distributing merchandise. One has the interests of the users of his products constantly in mind. He prosecutes research for their benefit—and they buy more. He has no desire for every last penny. He wants purchasers to do well with what he sells them and is pleased when they are beholden to him for their success. If there is a squeeze in the market, he is as easy as he can be with his old customers. Then, when a slump comes along, many of them will stand by him. He has chosen his walk of life not only for his financial welfare but also for his health. He wants to live an agreeable life. Having established good will, his worry is decreased to a minimum, and this preserves his health. It is a pleasure to work for such a man.

The other has an eye only for what he can see in his balance sheet. His philosophy of trade is that if he can beat his competitors in prices the trade will belong to him. His advantage he believes to consist in cutting down production costs by the elimination of such overhead charges as research and service, and the reduction of salaries and wages. He thinks his customers are as mean as he is, that they too are not in business for their health, and that they are out for every last cent.

The last cent is the most expensive of all earnings. He who would gain it destroys his personnel, because his competent men will leave him as soon as they can. The lame ducks will stay on. He destroys his best means of reducing costs, which follows in the wake of a contented and loyal staff, anxious to improve methods. And the worry that comes from being without friends is likely to undermine his health.

The elder ROTHSCHILD once said that he accounted for his fortune by his willingness to buy at prices above the bottom and to sell at those below the top. Some hopeful rothschildettes of today have not mastered this principle.

Research Is the Plow of Industry

> Behold the days come, saith the Lord, that the plowman shall overtake the reaper, and the treader of grapes him that soweth seed; and the mountains shall drop sweet wine and all the hills shall melt.—*Amos*, ix., 13.

THAT is our text. Now follows the sermon. Observe, please, the diligence of the plowman and the wealth and prosperity which accompany it.

Research in Germany under present conditions costs about one-tenth of that for the same work in America. It is again being prosecuted with vigor by leading chemical companies. There is also such stress of need there as to make Necessity conceive many inventions. These are being brought to fruition in the various German industrial research laboratories. They provide materials and goods that are needed, short-cuts in manufacture, improvements in yields and in qualities. The American people will want them. A tariff wall will not keep them out after it becomes known that such novelties and improvements are available. The rights to produce may or may not be purchased, according to the attitude of the inventors or owners. If they are purchased, only one manufacturer will profit by them. And in patent cases the United States courts are increasing their frown at those who evade protected rights by trickery.

The only way to meet research is to catch up with it, and the only way to catch up with it is to get a gait on; to have a good, long running start. This takes time, a long time, and energy and patience and character to deal with negative results; and above all things intelligent direction from an understanding mind. It is sheer lunacy to attempt to organize an industrial research laboratory without these exceptionally rare qualities, or even to expect results until, like KIPLING's ship, the research organization has found itself.

With such an organization achieved, however, it is the most precious possession of an industrial establishment. It insures the future. It is evidence that the directors are not stock-jobbers who want to sell out, but rather true manufacturers who want to maintain the organization as a monument to their wisdom. That is, after all, the right and, indeed, the only way to protect stockholders. Research is more important than dividends, because it provides for them. What the pseudo-business man can not see—and by this we mean one who is a speculator, whose principal interest is to buy

and sell shares, who gets control and operates with a view to selling out—is the time factor in the sequence. Dividends follow research with such sureness that, under proper organization, one can fairly predict dividends to come by the number of men engaged at research. It is merely a matter of time, under good administration.

Art is long, but life is brief. Most of us learned this at school, with our early Latin. But science also is long. It will not work under snap judgments. It requires understanding and continuous study.

Large corporations are cumbersome, and it is difficult to make changes in them. The balance sheet does not show the reserve assets of research or the threatening liability of its lack. Without sound research in science to guide them, they are riding for a fall. Research is the plow of industry.

The Greater Vision Of Chemistry

"FOR we like sheep" we used to sing in the oratorio; "for we like sheep; like sheep have gone astray-hay-hay; like sheep have gone astray! Have gone astray!" And without doubt we have; every mother's son of us. But that is not the end of the simile. Like sheep also we follow on without much thought.

For many years we have entered into the great pasture of chemistry by the Gate of the Elements, and we think the question fair whether, in the light of present study, this is the proper portal. We miss a wonderful road by making for that entrance with all our might.

Just because we used to think the elements were the alphabets of matter we cling to the familiar expressions and bring in the dull phraseology of tradition whenever we talk about chemistry. That makes the language of chemistry dull. As proof of this, pray imagine yourself in a company of intelligent persons and the lively attention that would be paid if you were to say, "I have a story to tell of human reactions." Or if you offered to speak of a new note in architecture or of any of the fine arts. But if you commence, "Here is a chemical story," most persons will breathe a sigh of regret and hope that your discourse will not be long. Matter doesn't begin with the elements, and the elements are not eternal and everlasting, as we used to declare, although many of us were never completely convinced of it. Then why should chemistry begin with elements and acids and bases and salts? These are specifications. What the non-technical but interested public wants is a bigger picture.

The dogma that elements are eternal is discredited. It isn't so any more. It doesn't do us any good or make us better chemists to believe it. Elements are in the making in the sun and in the stars. They are in disintegration in the earth and in planets and moons. There is no sign of a beginning and no sign of an end. Elements are mere stages in the cosmic history of matter. Some are very short-lived and others long-lived, but it appears that not one of them can withstand cosmic time.

There is poetry in this vision of the great cycle of creation, if we can arouse our imagination and cease to be like sheep for a little while. True, our own lives are very short, and we sense but little of what is all around and about and beyond us. But the life of humanity is long, and our living places are in the very heart of this great and enduring life of humanity. What are we doing for it?

The Irreducible Minimum

DAILY papers last week carried more or less news about the President's message transmitting the budget. He pointed with pardonable pride to the great achievement in reducing the estimated expenditures for general and civil functions from $1,330,000,000 to $1,130,000,000. This saving of two hundred million dollars is certainly due in greatest measure to the President's own insistence upon rigid economy in all the executive and departmental activities; it has been materially helped by the recently inaugurated budget system common to all modern enterprises except government.

Expenditures for military functions remain constant at 1½ billion dollars. Refunds and losses for the next fiscal year are estimated at 125 million less, and fixed charges have been reduced 135 million. Thus, two of the principal items responsible for the reduction in total estimated expenditures from $3,700,000,000 to $3,200,000,000 have come about by a shrinkage in our inherited obligations—the real reduction has been in the current governmental expenditures, other than for war. Certainly a reduction of 15 per cent in administrative expenses is a notable achievement. Maybe some day we can do as much to the army and navy.

But that contingency does not seem to be favored by the President. In casting about for further means of curtailing expenses he says:

"There is, however, another field of governmental operation—a rapidly broadening field of government expenditure—which may be discussed with profit to us all. I refer to expenditures which are being made from appropriations for federal aid in lines of research, improvement and development which, while having no direct connection with the operations of the business of government, have grown to become a recognized part of its activities. It is not easy, therefore, to divorce from our minds the fact that considerable of the moneys appropriated for the government are spent for those things which do not pertain to the normal functions or operations of the business of government. There is question as to how far the government should participate in these extraneous activities, and I am frank to say that an answer to the question as to whether we can look forward to any further material reduction in the expenditures of the government in future years depends largely upon whether or not there will be a curtailment or expansion of these activities."

Not wishing to indorse wasteful expenditure in any governmental activity, we cannot help but be reminded that most of the governmental activities for research, education and development are at present in crying need of funds for executing the work they have been commanded to do by the law which established them. It is a difficult if not an impossible task to segregate the cost of these operations, but as a matter of fact all of them certainly total to less than 75 million dollars. More than half of this money is spent by the Department of Agriculture in studying plant and animal diseases and in educating the farmer. Knowing how the farm bloc dies but never surrenders, the President would apparently direct the next cut in appropriations toward such activities as center in the Bureau of Standards, Bureau of Mines, the Coast and Geodetic and Geological Surveys.

What would be the result?

Two years ago, the late Dr. ROSA of the Bureau of Standards analyzed the first budget and discovered that the country was then (after two years of peace) spend-

ing a dollar for war to a penny for progress. Even then the scientific services were seriously undermanned and scandalously underpaid. Comparing the items of Dr. ROSA'S list with those from the budget ending June, 1923, and listed in the right hand column of the attached table, it is found that the current appropriations call for about the same amount of money as was spent in 1920, except only that the Bureaus of Education and Vocational Education have together been increased 6 million dollars, Farm Management 3½ million, and the Bureau of Mines ½ million.

COMPARATIVE BUDGET ESTIMATES

	1924	1923
Agricultural Experiment Stations	$1,743,600	$1,748,600
Extension and Co-operative Services	7,388,730	7,345,600
Weather Bureau	1,946,235	1,925,235
Bureau of Animal Industry (less meat inspection)	5,819,426	6,076,896
Bureau of Plant Industry	3,096,470	3,632,910
Forest Service (less receipts)	5,723,582	5,732,302
Bureau of Chemistry	1,339,031	1,277,631
Bureau of Soils	310,775	371,775
Bureau of Entomology	1,772,880	1,803,080
Biological Survey	840,625	870,565
Bureau of Standards	1,742,360	1,547,360
Coast and Geodetic Survey	2,236,015	2,213,135
Bureau of Fisheries	1,244,090	1,262,090
Bureau of Education	3,196,560	3,122,960
Geological Survey	1,576,090	1,450,940
Bureau of Mines	1,782,700	1,580,900
Howard University	283,000	190,000
Total	$42,102,169	$42,151,979

Obviously, the investigative and educational activities of the government have not been overextended in the last three years. Perhaps, in view of the great pressure which has been brought to curtail governmental activities, it should be a matter for congratulation that these budget items have not been sharply reduced. As noted in the above table, which compares the proposed expenditures for next year with those allowed for the current fiscal period, the chief governmental activities looking toward progress and improvement have so far been able to deflect the axe of the terrible General DAWES. It is now incumbent upon all of us to let our representatives understand that the present budget represents the very minimum. Most of the money now goes for overhead. For real utility the appropriations must be increased; if further decreased, they might as well be eliminated entirely.

Volume and Kind Of Business

ALL of us are interested in "How's business?" Some of us show a sordid spirit in asking the question. Others do not, but all are interested. There are innumerable trade reports, the number constantly increasing. There are the trade papers, the circulars of banks, trust companies and stock exchange houses and the studies of economic institutions, while finally the United States Government itself, through the Department of Commerce, circulates very comprehensive statements, all on the subject of "How's business?"

We are studying, or at least talking, economics at a great pace these days and we are also developing psychology. The two go together in considering the individual. Take, then, the case of the individual in connection with this matter of how is business. Judging by what one hears and sees, the common conception as to the state of business is a quantitative conception. It is a question of how much business there is. The form of speech used betrays the mental concept of quantity being the important element, for ordinarily business is not referred to as being large or small, heavy or light, but as being "good" or "bad."

Is this really the right conception from the standpoint of the individual? If business is large or active, he is moderately sure of having a job. But is having a job the *summum bonum* of the individual? Merely having a job is not so much after all. The job may be an unpleasant one. The income derived may not buy what the individual wants. Perhaps 10 years ago the income received and the market price of the things desired struck a balance, while now there is a lack of balance. Perhaps the income is doubled in 10 years, but the total cost of the things desired is trebled. Merely having a job is not sufficient.

Business can be heavy, or large or active, and therefore "good," according to the common conception, whereby each individual has a job, but without the individual being able to buy with his income what he ought to have, and without the total wealth increasing. Things may be done so inefficiently that all the work does no more than provide a mere subsistence, with no savings and therefore no advancement or progress, hence no real prosperity. It is not then a question merely of the quantity or volume of business, but also of the kind of business. Is the business of such a character that it involves improvement, advancement and progress, or is it merely working for a bare existence?

We should distinguish between merely active business and really helpful and progressive business. "How's business?" should refer not merely to quantity but also to kind or quality of business.

Industrial Management And the Buyers' Market

THOSE of our readers who are familiar with the forecasts of the Babson organization and other similar economic services, or who have put the matter to a searching personal analysis, are well aware that industry at the present time and for some period to come must encounter what is technically known as a buyers' market. That is to say, the future demands of consumers will be so hesitant, so difficult to crystallize into actual sales, and the capacity of industry to produce will so far exceed this demand that the buyer must be studied as never before and all ends must be shaped to his wishes. What is management to do to meet this condition?

As an unusual exposition of this situation and a terse analysis of the problem confronting management, the recent address of Dr. H. S. PERSON of the Taylor Society—"Shaping Management to Meet Developing Industrial Conditions"—is worthy of serious study. This paper, which will be found elsewhere in this issue, gives a particularly clear and germane view of market conditions and how management must change to meet them. Although directed to industry in general, it is of inestimable importance to the chemical and closely allied industries.

Dr. PERSON'S conclusion is more than apt, and all in executive positions, high or low, will find it a valuable subject for continual reference. What better message can be brought to industry today than this: "For a quarter century before the war even poorly managed enterprises were helped in their ascent to the heights of prosperity by the escalator of a sellers' market; now that escalator is out of commission, and the ascent to new prosperity must be achieved in the good old-fashioned way—by good management muscles, good management lungs and good management brains."

Readers' Views and Comments

Galvanic Corrosion on Yacht Sea Call

To the Editor of Chemical & Metallurgical Engineering

SIR:—Referring to your issue of Nov. 15 and the letters by Mr. Hough and Mr. McKay on the subject of galvanic corrosion on the yacht Sea Call in which reference is made to some questions asked by me regarding the disintegration of the Monel yacht Sea Call, I will say that shortly after the meeting at Montreal I wrote to George Lawley, president of George Lawley & Son, Inc., builders of the Sea Call.

The following is Mr. Lawley's statement on the subject, which bears out the statement made by Mr. McKay.

Cleveland, Ohio. HENRY HOWARD.

Your letter of Oct. 11 received, and in reply would say that you have not been really and truly informed as to the trouble with the Sea Call. I think that Monel metal is a very good metal for a great many things. In the case of the Sea Call, if you remember, she was entirely plated from about one foot above the load waterline with Monel metal and the rivets we used were also Monel metal and not iron or steel. We found it impossible to obtain, after many trials, a stern post, or stem, and the architects finally informed us to use steel, which was done. As this was only a very small portion of the real surface below the waterline, and there being so much Monel metal—practically her entire body—electrolysis set up and would eat the stern post and stem very, very fast. The owner was so disgusted with the condition that he decided to break her up, which was done, as nothing could alter him in his decision. The Monel metal did not disintegrate and was not rotten. It would foul, however, in salt water very fast, a fungus-like grass would grow on that metal in 2 or 3 weeks, 4 or 5 in. long. This also disgusted the owner, as the idea was that it would not foul and that the expense of hauling out in foreign countries would be eliminated.

The steel framing of course was not affected in this case, as the water did not get to it, but the effect was so marked from action of the Monel metal that even the chain when at anchor, the tide running one way and perhaps the wind the other, was being eaten by electrolysis.

Any other information in regard to this craft I should be very glad to give you and when you are here I think you can find small samples of how it would eat steel. (Signed) GEORGE W. LAWLEY.

What Is Steel?

To the Editor of Chemical & Metallurgical Engineering

SIR:—Your simple and effective answer to the question, "What is steel?" is highly commendable. In the interest of completeness I might add that the boundary between pure iron (ferrite) and steel may be sharply drawn from metallographic observations.

Thermal analysis shows no A_1 point in pure iron-carbon alloys until the carbon content is increased over about 0.03 per cent. By way of illustration I inclose several thermal curves of such alloys having carbon contents both above and below that figure. (Fig. 1.)

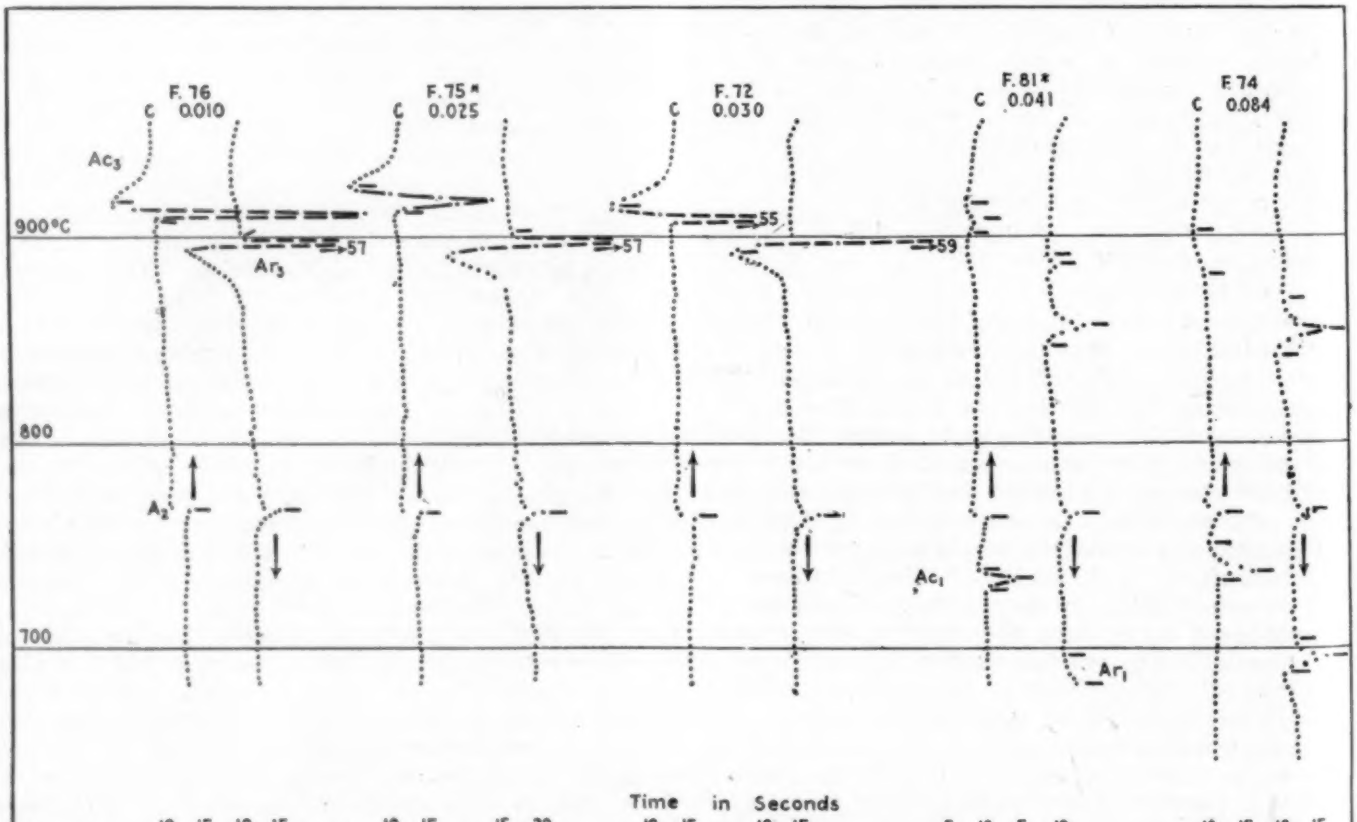


FIG. 1—HEATING AND COOLING CURVES OF VARIOUS PURE ALLOYS OF IRON WITH A SMALL AMOUNT OF CARBON

The presence of A_1 can be equally well established also by miscroscopic examination—i.e., no pearlite islands can be found when the iron contains 0.03 per cent carbon or less. It is thus evident that there exists a natural boundary between iron and steel readily fixed metallographically.

Having offered a simple and accurate definition of steel, why not do likewise for the constituents of this much abused metal? It would be quite a satisfaction for one to be able to discuss problems in heat-treatment with metallurgists without the necessity of a preliminary agreement on the meaning of the essential technical terms used.

HOWARD SCOTT,
Associate Physicist.
Bureau of Standards,
Washington, D. C.

Chemists in Public Life

To the Editor of Chemical & Metallurgical Engineering

SIR:—In connection with your editorials urging chemists to interest themselves in civic affairs it may interest you to know that the city of Stamford, Conn., has elected a chemist for Mayor. Major Phillips, of the Phillips Chemical Co., manufacturer of milk of magnesia, is an active member of the Stamford Chemical Society. He was elected Mayor on the Democratic ticket by a large majority in a city which is normally overwhelmingly Republican.

Our Stamford Chemical Society at its October meeting arranged a program dealing with problems of garbage and sewage disposal, which have become very acute in our community. The members of the city administration and the opposing candidates for the Mayoralty were specially invited guests and took part in the discussion.

R. H. STEVENS,
President.
Stamford, Conn.

Metallurgical Education

To the Editor of Chemical & Metallurgical Engineering

SIR:—I have read your editorial on Metallurgical Education in the issue for Nov. 22 with much interest as well as Dr. Little's report on Chemical Engineering Education which has just appeared.

Your description of the evolution of a new course in Metallurgical Engineering is probably not overdrawn as representing its first stage in some instances, but this stage is usually transient if sufficient funds are available for expansion. Almost any new course, especially where apparatus is involved, requires a large capital investment at the start. Tremendous capital has been required in recent years to take care of the enormous increase in students entering our schools as well as for the evolution of new courses. This achievement is indeed a convincing proof of our wonderful response to educational needs. The advance in primary and secondary school work has been scarcely less astonishing. I am very much inclined to think that our personnel for "white collar jobs" is in danger of growing too large while our personnel for the ordinary workaday jobs is decreasing in numbers and in efficiency.

I do not believe in standardized courses, because the needs of one locality are different from those of any other locality. We should rather try to fit men for locally important industrial needs. The few who do not fit into this scheme will be able to suit themselves at some other locality without great hardship. Our work must be intensive to be really effective. But the best result in product comes through the careful selection of the teachers. Personal traits in the teacher have far more to do with the result than a good curriculum. Mr. Dow's letter shows that he still feels keenly the effects of Dr. E. W. Morley's wonderful personality. We have a great many such teachers giving their all in this service unselfishly, and the attempt to substitute anything else must meet with failure.

The beginner in my time had only to make the acquaintance of atoms and molecules; now we have electrons, ions, atoms, molecules, crystal aggregates, colloids. The capacity of the student has not greatly increased. If we do not decrease the surface covered and invent better teaching methods, he must inevitably contract mental indigestion. One of the crying troubles of most teachers is their inability to imagine themselves in the position of the student. They forget that it has required years of training to acquire what seems now so simple, and they constantly shoot far over the head of the beginner, to his stupefaction and dismay.

EDWARD HART.
Lafayette College,
Easton, Pa.

Polish Chemical Industries

THE chemical industry connected with agriculture was already very far advanced in Poland before the war, for it constituted one of the sources of her great wealth; it should soon not only return to its former height of development but also make further progress. The status of the chemical industry in that country is described in an article in *Poland*, for October, 1922.

Sugar constitutes the most important branch of this industry, especially in Poznania and Congress Poland —the pre-war output amounted to about 700,000 tons. Many sugar factories were destroyed during the war, especially in Congress Poland, and the present production is only about one-third of the output produced previous to the war.

FOOD PRODUCTS

The united provinces of Poland form the chief European center for the culture of potatoes. The chemical industry which is dependent upon this product, such as alcohol, starch and sirup, is highly developed. The industry of drying potatoes (flaked potatoes) is carried on to a great extent in Poznania.

The brewing and malt industry of Poland is advancing rapidly; the species of barley grown there is of superior quality and a considerable quantity of hops is cultivated in Congress Poland and Volhynia.

During the last few years before the war the milk factories of Congress Poland and Poznania were largely employed in manufacturing technical byproducts of milk.

The manufacture of the byproducts of fruit and vegetables (jams, preserved fruit) was very insignificant, whereas the manufacture of the byproducts of sugar (cocoa, chocolate, sweetmeats) attained considerable importance in Congress Poland.

There are several large factories employed in producing soap, candles and glycerine, and in extracting fats. Today the outlook is more hopeful for this special branch.

CHIEF INORGANIC CHEMICAL INDUSTRIES

Sulphuric acid is produced in large quantities and very cheaply in Upper Silesia, as it is the refuse obtained when smelting zinc ore, and as a result of the importation of pyrites from Spain, Congress Poland has also been enabled to produce a considerable quan-

tity. Besides the Upper Silesian factories, there are also many large sulphuric acid and "oleum" works active in Congress Poland, Malopolska (Galicia) and Wielkopolska (Poznania).

Kitchen salt and brine are found in large quantities in certain districts of Poland. This is of great value to the future development of this branch of chemical industry which produces soda (common and caustic), muriatic acid, chlorine, bleaching lime, etc.

A great quantity of ammonium sulphate and cyanide of lime is produced from nitrogenous compounds in Upper Silesia and by the oxidation of synthetic ammonia.

Salts of potassium, which are in great demand both for artificial manure and in chemical industry, are to be found at Kalusz. Bertolet salts are manufactured in several factories and potassium nitrate is manufactured at Bory, near Krakow. Poland has yet another means of obtaining salts of potassium—viz., from the wash from molasses distilleries. Before the war several factories in Congress Poland were employed in producing carbonate of potassium from distillers' wash and potash from the strontium lye which is obtained when refining molasses.

Superphosphates are produced in valuable quantities in a number of factories in Congress Poland, Wielkopolska and Upper Silesia. This special line of chemical industry was ruined in Congress Poland during the war, but it is now beginning to revive again.

Dyestuffs are produced in several large factories and in many small ones. Salts of aluminum—i.e., sulphate of aluminum and other less important mineral products—are manufactured in several factories in Congress Poland.

Chief Organic Industries

During the last few years before the war Poland produced about one million tons of petroleum per annum. The industry of distilling rock-oil in order to obtain motor spirit, petroleum, lubricating oil, paraffine, petroleum asphalt and coke, has made rapid strides, although a fair quantity of crude oil is exported to other countries.

Since there is a lack of coke-producing coal in Congress Poland and Malopolska, the coke industry does not exist in these provinces, but it is exceedingly well developed in Upper and Cieszyn Silesia. Coal pitch, which is a residue from the gas and coke ovens, is distilled in order to obtain aromatic carbohydrogens, phenol, various oils and pitch; but this industry is extensively carried on only in Upper Silesia.

In spite of the abundance of raw materials, the dry distillation of lignite and turf is scarcely known in Poland, though it is an industry which would be of great advantage to the country. In view of the great extent of forest ground in Poland, the dry distillation of wood will doubtless become a very valuable industry. Before the war it attained extraordinary proportions in a primitive form. At the time of the war Poland started to manufacture pitch, turpentine and resin from the waste matter of pines which results from the felling of the same.

The manufacture of the so-called intermediate products of the synthetic organic industry, such as the mass-production of aromatic nitro-compounds (nitrobenzol, etc), amines, aniline, sulphuric acids, etc., was not very extensive in Poland before the war, except to a certain degree in Upper Silesia. Today, especially after the annexation of Upper Silesia, the needs of the country enforce a greater interest in the corresponding branches of the industries connected with the manufacture of colors, explosive materials, etc. The synthetic-organic industry, in particular the manufacture of colors, has made great progress in Poland, especially in Congress Poland, where there was a wide market for it. Today there is every prospect of further development, particularly after the annexation of Upper Silesia, for this latter province supplies Poland with a large quantity of raw material.

For obvious reasons, the manufacture of explosives was practically an unknown factor in Poland before the war. Now, however, it is being speedily organized, and in the near future Poland will no doubt be in a state to supply her own demands in this respect.

Other Chemical Industries

Before the war, tanning was a most important branch of industry in Poland, especially in Congress Poland, where it was technically in a flourishing condition. Several large factories in Congress Poland are employed in the production of tanning extracts. Nearly all the raw materials are supplied by foreign countries, partly by the Ukraine, but principally by North America.

The production of vegetable and animal fibers and subsequently bleaching, dyeing, printing and the finishing process of tissues and yarns is an important branch of chemical industry in Poland. The factories are well equipped technically. Congress Poland also possesses two artificial silk factories. Factories for the manufacture of rubber and celluloid and their byproducts, as well as other artificial plastic masses, are almost unknown quantities in Poland—a lack in Polish industry which will no doubt be rectified in the near future.

Manufacture of Essential Oils in 1921

The Department of Commerce announces that the census reports show a considerable decrease in the activities of the establishments engaged primarily in the manufacture of essential oils (not including synthetic or artificial oils) during 1921, as compared with the year 1919. The total value of products reported amounted to $3,271,120 in 1921, and to $5,698,403 in 1919, a decrease of 42.6 per cent.

Detailed statistics for the years 1921 and 1919 are given in the following table:

Products		1921	1919	Per Cent of Decrease
Total value of products		$3,271,120	$5,698,404	42.6
Oil of:				
Peppermint†,	pounds	152,134	236,233	35.6
	value	$368,353	$1,276,136	71.1
Spearmint‡,	pounds	99,056	29,985	*230.4
	value	$356,274	$145,709	*144.5
Cloves,	pounds	199,200		
	value	$335,376		
Nutmeg,	pounds	19,795		
	value	$21,939	$2,950,961	45.0
Sandalwood,	pounds	23,835		
	value	$178,968		
Other oils,	value	$1,086,507		
Witch-hazel extract,	gallons	(§)	510,110	
	value	(§)	$448,938	
All other products,	value	$923,703	$876,660	30.3

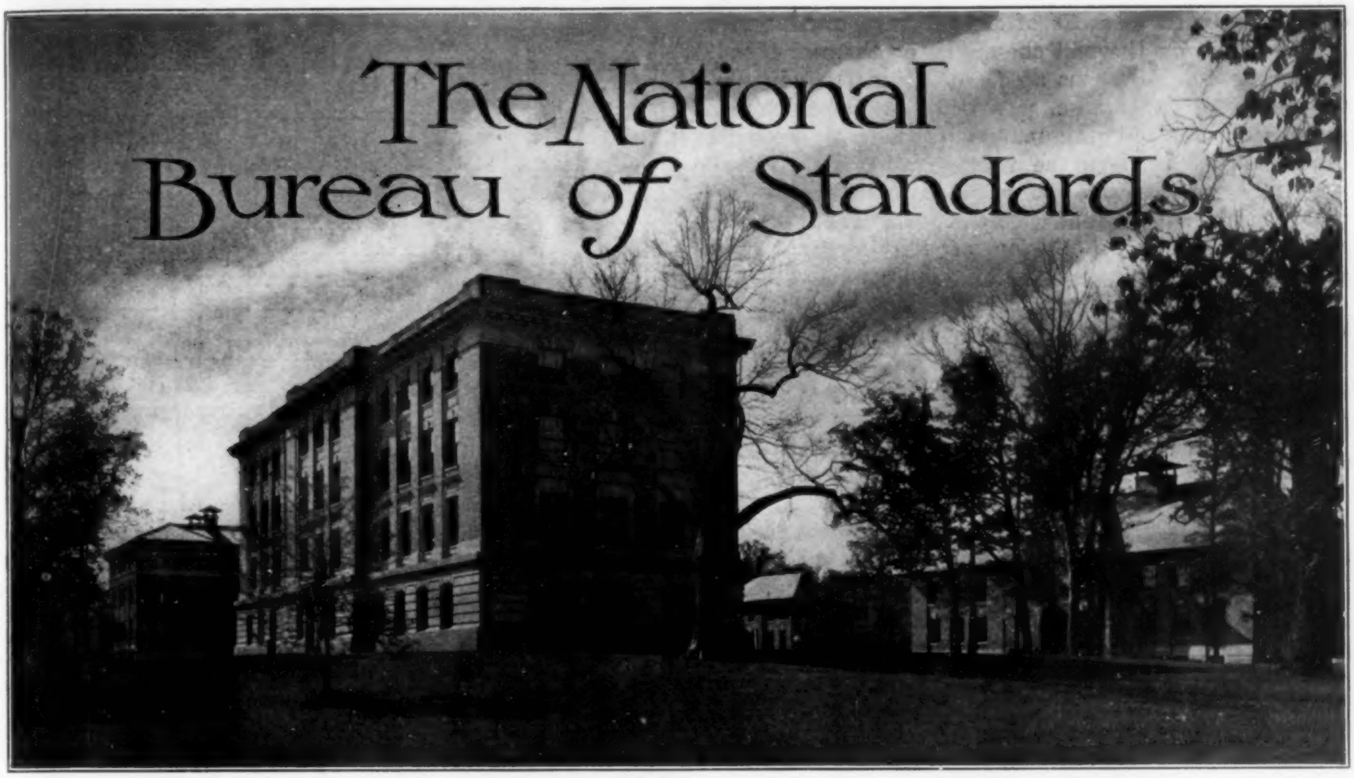
* Increase.

† Crude and refined are combined to avoid disclosure of operations of individual establishments.

‡ Crude only. No refined spearmint reported in 1921 or 1919.

§ Included in all other products to avoid disclosure of operations of individual establishments.

The returns indicate that the combined output of all establishments was approximately 56 per cent of the maximum capacity based upon a demand requiring full running time.



A Discussion of the Organization and Functions of the Bureau, Types of Standards Investigated, Funds, Personnel and Methods—Relation of Industrial Research and Technical Work to Fundamental Studies of Constants and Research in Pure Physics

By R. S. McBride
Assistant Editor, *Chemical & Metallurgical Engineering*

THE National Bureau of Standards, which was established in 1901 for the service of science and industry, has become the greatest physical laboratory in the world. At this time the organization and work of the bureau are of particular interest because of the change in directorship incident to the resignation of Dr. S. W. Stratton. The question has naturally been raised whether the new director, who has not yet been designated, will continue the work at the bureau along existing lines or will tend to divert it into new or different channels. For a clear understanding of any such problem, the present scope, organization and activities of the bureau must be considered.

Five Types of Standards

Probably the idea of standards suggests to nine out of ten persons matters of weight or measurement. As a matter of fact the "standards of measurement," to which the bureau gives much attention, form only one of five groups of standards to be considered. Standard constants, standards of quality, including specifications for materials of all sorts, standards of performance for machines or devices, and standards of practice, including codes of regulatory laws of a technical sort, also come under the attention of this institution.

These five types of standards have been outlined and the purpose of each has been shown clearly in a function chart published by the bureau, which is reproduced herewith. This brings out clearly the relationship of the different kinds of work to the fundamental function of the bureau—namely, "development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry, and commerce."

Internal Organization

Because of its location, the Bureau of Standards has been organized to function almost independently of the rest of the Department of Commerce. This has necessitated complete mechanical and clerical organization, in addition to the scientific divisions of the bureau. The interrelation of these parts is shown on the organization chart, from which it can be seen that the scientific work of the bureau has been divided primarily into divisions of physics—heat, light, electricity and other branches. More recently there have been added divisions to deal with problems of particular industries such as the problems of physical metallurgy and of scientific ceramic manufacture. Problems of structural engineering and miscellaneous engineering materials are grouped together in another division for convenience of administration.

The special activities of the bureau which have been added since Mr. Hoover became Secretary of Commerce are in special groups dealing with problems of building and housing, simplified commercial practice and trade specifications that work closely with the Department of Commerce and less intimately with the research divisions that have hitherto formed substantially all of the bureau.

This type of organization has been intended to bring together under a single division chief the varieties of research and investigation requiring common methods for their study. Thus men having particular ac-

quaintance with methods of temperature measurement and research on thermal chemistry or thermal physics are engaged on problems applicable in many industries. Thermometer calibration, pyrometer development, heat conductivity of building materials, thermal properties of substances used in the refrigerating industry, the properties of refractories at high temperature, and many other subjects and commodities are thus considered in the heat division of the bureau. Other phases of investigations on the same commodities are often going on simultaneously in different divisions, especially where electrical properties, chemical properties or optical properties of the materials are involved. Only in the case of a limited number of industrial products having large importance from the standpoint of the government have separate sections been organized along commodity lines.

This type of staff organization has followed somewhat the lines which determine college organization. In fact in many respects the Bureau of Standards resembles closely a graduate institution where the scientific staff is engaged upon researches of greater difficulty and complexity, but otherwise similar to those done by the graduate students and teaching staff of any university.

Personnel and Appropriations

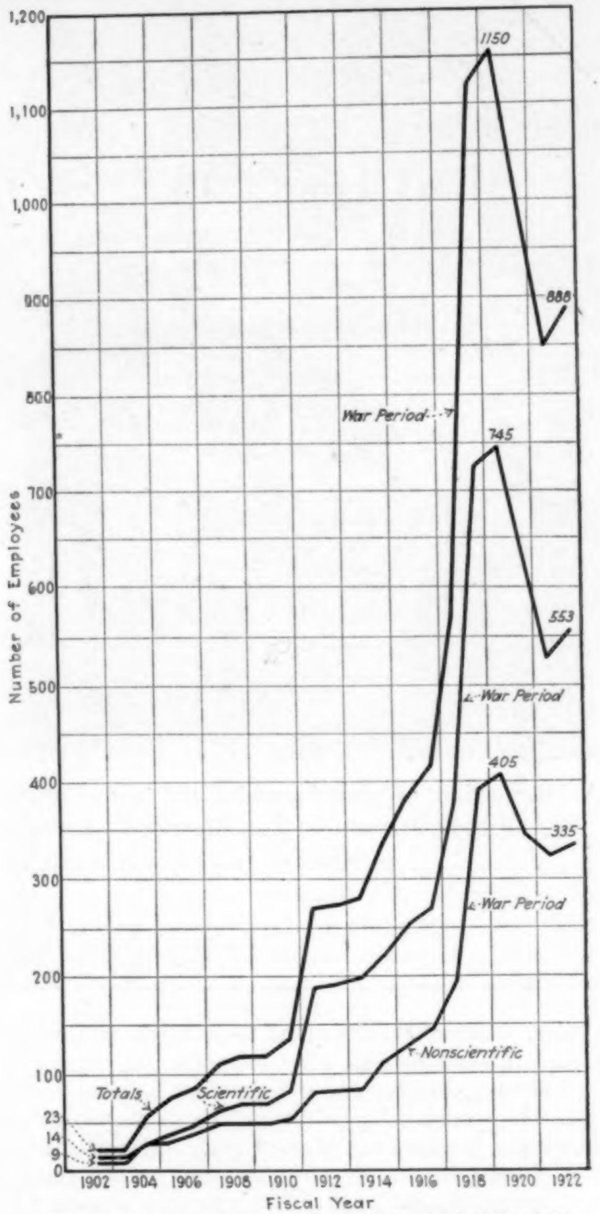
The Bureau of Standards was founded in 1901 with a total personnel of twenty-three, of whom fourteen were members of the scientific staff and nine of the non-scientific. From that small beginning, which was virtually only a weights and measures office, the bureau grew to a personnel of 1,150 at the end of the war period. However, much of the war-time growth was not of a sort that could be expected to continue, and at present the scientific staff consists of approximately 550 persons supplemented and assisted by 335 non-scientific staff employees. The growth in personnel is brought out most clearly by the graphical presentation of data given herewith.

The scale of salaries paid to the scientific staff during the early history of the bureau was comparable with or slightly better than the college and university salaries of the country. However, during recent years the bureau has experienced great difficulty in getting the most desirable type of men to leave other positions and come to Washington, because the financial conditions were anything but attractive to them. The maximum salary paid is, of course, for the director, $6,000 per year; and the salaries scale down from this to about $1,500 as the average entrance salary for scientific and technical men. A large majority of the staff receives between $1,000 and $3,000 per year, only about 15 per cent of the total number being paid $3,000 or higher. When one realizes that the organization is almost altogether a research organization, the complication this limitation produces is evident.

APPROXIMATE TOTAL EXPENDITURES
Bureau of Standards
Fiscal Years 1902 to 1922

1902	$165,000	1913	$680,000
1903	145,000	1914	625,000
1904	340,000	1915	685,000
1905	170,000	1916	730,000
1906	170,000	1917	950,000
1907	170,000	1918	2,990,000
1908	185,000	1919	3,360,000
1909	245,000	1920	1,890,000
1910	420,000	1921*	1,319,000
1911	470,000	1922	1,507,000
1912	500,000		

*Excluding funds transferred from other departments.



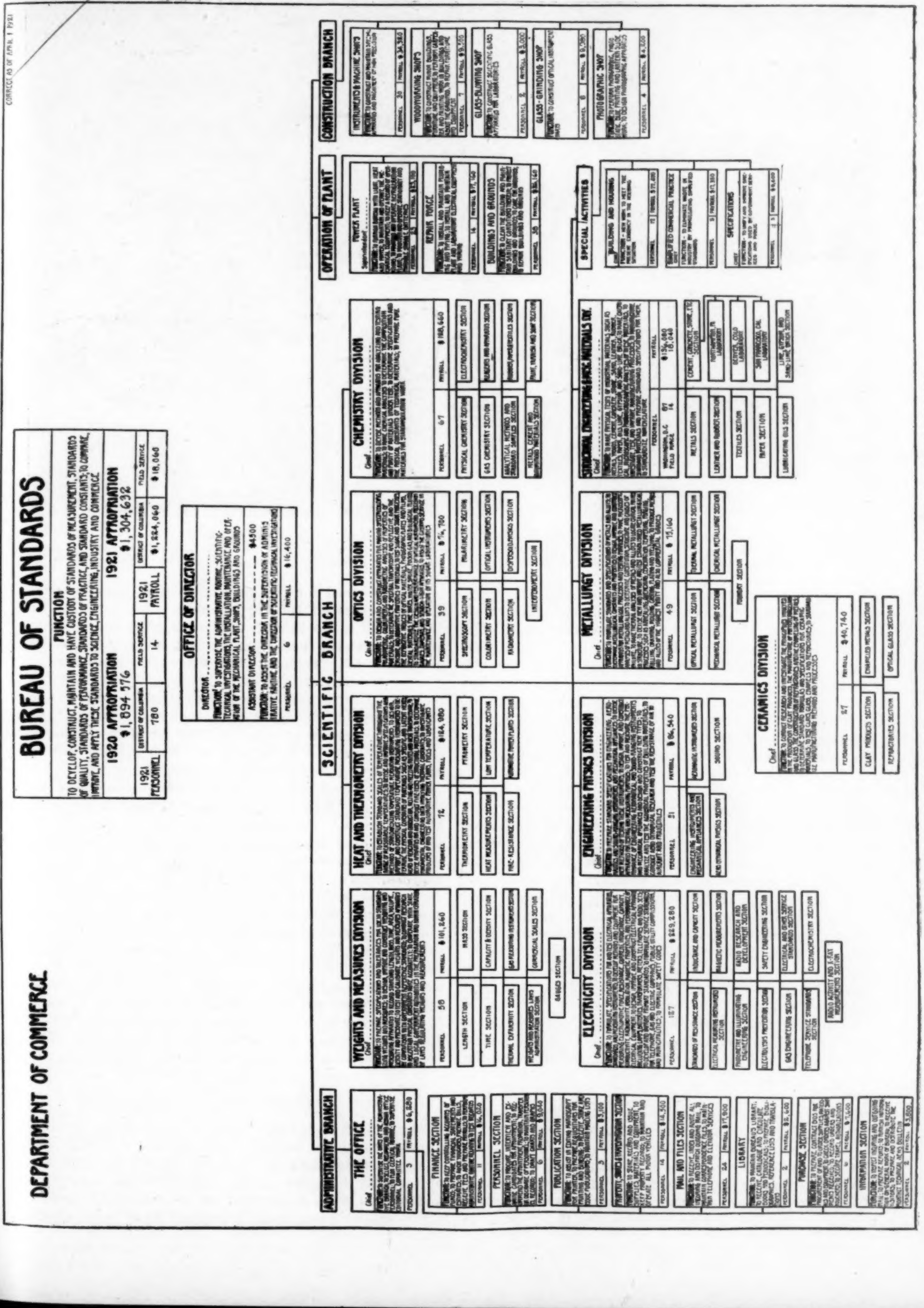
PERSONNEL BUREAU OF STANDARDS, 1901-1923

The growth in appropriations has been about parallel to the growth in personnel. The approximate total expenditures of the bureau during its first 21 years are given in the accompanying tabulation. Of this total expenditure, slightly more than half has been for salaries, the remainder representing expenditures for apparatus and equipment, travel, and the multitude of operating expenses which any institution of such size occupying a group of twenty-four buildings is bound to incur.

Of the total expenditure during its life a large sum has gone for permanent buildings and grounds. Probably five or six million dollars is now so invested.

Of the expenditures since 1910 a very large proportion has been from appropriations granted as "special funds," which are sums of money given for the conduct of specific lines of work with no limitation as to the percentage for salaries, equipment, travel or other subdivision of the work. The influence of these special funds on the rate of increase in number of employees and total expenditure is evident from the curves and tables of data. At present a very large part of the total money is appropriated in this way.

Although established primarily as a bureau of phy-



ORGANIZATION CHART OF THE NATIONAL BUREAU OF STANDARDS

AIRPLANE PHOTOGRAPH SHOWING GROUNDS AND BUILDINGS OF BUREAU

A—Heat and Engineering Physics. *B*—Administrative and Optics. *C*—Radio. *D*—Metallurgy. *E*—Shop. *F*—Electricity. *G*—Chemistry. *H*—Industrial Research.

sics and physical research, the Bureau of Standards has always included a considerable number of chemists and engineers. In fact the chemical division of the bureau has been one of the largest, including during recent years a total personnel of approximately one hundred. The number of engineers on the staff has also grown in proportion as the technical activities of the bureau have increased. It is the relation of these technical problems to the fundamental studies in physics that have made it difficult for many to understand the work of the bureau.

In the beginning the bureau gave practically all its time to studies of weights and measures and fundamental problems in heat, light, electricity or mechanics that one commonly associates with a physical laboratory. However, the application of such studies to the practices of engineering and industry was always an important part of the motive behind the work; and with increasing knowledge, the bureau acquired increasing contact with those active in industrial lines. More and more commercial laboratory men came to the bureau for information and more and more other government departments referred to it the problems of tests and purchases.

With the transfer to the Bureau of Standards of part of the Technologic Branch of the U. S. Geological Survey and later of the Contracts Laboratory of the Bureau of Chemistry, the Bureau of Standards was made in effect a supervisor of purchases for the government in so far as standards or specifications were involved. This did not make compulsory the reference of such problems to the bureau, but it did make available to other government institutions the advisory services of the bureau in such a way that many thousands of tests for other government institutions are now made annually. In fact, during recent years the number of tests performed for the government and outside agencies has exceeded 100,000 per year.

In order to do this testing work most intelligently and fairly to all, the bureau made a study of industrial processes and products; and after the investigators became familiar with these subjects, publications of a technical nature were issued from time to time. Thus there grew up the basis upon which the bureau has now built what is in effect a "Bureau of Technology" closely interwoven with, and in some measure superseding parts of, the original "Bureau of Physics."

It is practically impossible to generalize as to the advantages and disadvantages of this technologic work at the bureau. Circumstances in each of the fifty or sixty divisions are so different that any generalization is bound to be wrong in the case of many of the commodities or the branches of physics or chemistry which are represented. It is safe to say, however, that the new director, whoever he may be, will have confronting him one general problem that can never be wholly settled—namely, To what extent can the bureau take up practical engineering and technical studies, and to what extent must it confine its effort to the problems of so-called "pure science"? It is, of course, out of place in this article to undertake any recommendation on this point; but it may be profitable to point out by typical examples some of the important factors involved in any plan for the work of this great institution.

Standard Specifications

The United States Government is one of the greatest purchasers in the world. Naturally the maximum efficiency in purchasing is desirable not only for the sake of economy but also as an example to the individual and to business. As pointed out earlier in this article, many of the government purchases have been super-

vised by tests made at the Bureau of Standards. However, this scheme did not procure general uniformity of purchasing and more recently there has been established the Federal Specifications Board, of which the director of the Bureau of Standards is chairman. This board arranges for the adoption of uniform specifications for purchases by all of the departments of the government, in so far as the requirements of the government are such as to make the adoption of specifications worth while.

Many of these specifications, though adopted primarily for government use, will undoubtedly have general influence upon trade practices of the country. In the past there have been many such cases where the government adopted for commodities such requirements as were recommended by the Bureau of Standards and thereby established a trade custom that enabled all purchasers of such commodities to get first-quality product. One of the most conspicuous examples of success has been the standard specifications for incandescent electric lamps adopted first more than 10 years ago. Now it is possible to get anywhere electric lamps in conformity with the latest government standards. Indeed these standards are almost of universal effect. This is possible, as they are invariably adopted with the co-operation and assistance of the most forward-looking scientists and engineers in industry and not by any academic consideration of theory considered alone by the government investigators.

In many respects this work on standard specifications at the bureau has been a pioneer effort, for often those industries that previously had not considered any specifications or requirements for their product now realize the industrial advantage to the producer of having well-established, reasonable and enforceable requirements of this sort. The impartial judicial position which the Bureau of Standards can take in such work has lent great dignity to its efforts and has perhaps contributed most of any single factor to such success as has been attained.

Standards of Performance

Just as standard specifications for commodities are desirable, so too are standards of performance for machines and devices. It is quite as important to know how to rate a machine and what tests can reasonably be applied to determine performance as it is to specify the composition, heat-treatment, size or other characteristic of any commodity or of any part of the machine or device. The relation of the Bureau of Standards to such work has not been limited to tests or performance requirements on government purchases alone, but it has been to a considerable extent so directed. Purchase of motors, fans and other small electrical devices according to performance tests made at the bureau has been one good illustration of how this effort has been worked out. More recently work of a similar sort on dry cells and storage batteries has been carried through to the adoption of generally acceptable standards of performance for such equipment.

Standards of Practice

In the case of standards of practice, the work of the bureau has been limited largely to studies on public utility practice and safety standards. Codes and regulations involving technical detail work demanded

---

Functions of the National Bureau of Standards

Development, construction, custody and maintenance of reference and working standards and their intercomparison, improvement and application in science, engineering, industry and commerce.

Standards of Measurement:

To aid accuracy in industry through uniform and correct measures;

To assist commerce in size standardization of containers and products;

To promote justice in daily trade through systematic inspection and regulation;

To facilitate precision in science and technologic research through calibration of units, measures, and instruments involved.

By standards of measurement is meant:

Reference and working standards for measurements of all kinds, including fundamental and derived standards of measurement for expressing the quantitative aspects of space, time, matter, energy and motion, and of their interrelations. By definition, specification, or material standard, covering, for example, length, area and volume; mass, weight, density and pressure; heat, light, electricity and radioactivity, including for each the quantity, flux, intensity, density, etc.

Standard Constants:

To serve as an exact basis for scientific study, experiment, computation and design;

To furnish an efficient control for industrial processes in securing reproducible and uniformly high quality in output;

To secure uniformity of practice in graduating measuring instruments, or in compiling tables for standards of quality and performance, and wherever such uniformity is desirable;

To aid laboratory research by reducing errors and uncertainty caused by use of data of doubtful accuracy.

Standard constants are defined as:

Natural standards or the measured numerical data as to materials and energy, known as physical or standard constants, i.e., the fixed points or quantities which underlie research and industrial processes when scientifically organized. Mechanical equivalent of heat, light, electricity and gravitation; specific densities; viscosities; melting and boiling points; heat capacity; heats of combustion; velocity of propagation of light; conductivities of materials to heat and light; electrochemical and atomic weights; and many similar magnitudes determined experimentally with maximum precision and referred to fundamental standards of measure.

Standards of Quality:

To secure high utility in the products of industry by setting an attainable standard of quality;

To furnish a scientific basis for fair dealing to avoid disputes or settle differences;

To promote truthful branding and advertising by suitable standards and methods of test;

To promote precision and avoid waste in science and industry by affording quality standards by which materials may be made, sold and tested.

Standards of quality comprise:

Specifications for material (by description, sample, or both), known as standards of quality, fixing in measurable terms a property or group of properties which determine the quality. The numerical magnitude of each constituent property pertinent to the quality involved, and specific magnitude in units of measure of such significant factors as uniformity, composition, form, structure and others.

Standards of Performance:

To clarify the understanding between maker and user as to operative efficiency of appliances and machines;

To make exact knowledge the basis of the buyer's choice;

To stimulate and measure mechanical progress.

Standards of performance include:

Specification of operative efficiency or action for machines and devices, known as standards of performance, specifying the factors involved in terms susceptible of measurement. Numerical statement of speed, uniformity, output, economy, durability and other factors which together define the net efficiency of an appliance or machine.

Standards of Practice:

To furnish for each utility a single impersonal standard of practice as a basis for agreement of all interests, clearly defined in measurable terms;

To insure effective design and installation of utilities;

To promote safety, efficiency, and convenience in the maintenance and operation of such utilities;

To secure uniformity of practice where such is practicable, and effective alternates in other cases.

Standards of practice are defined as:

Codes and regulations impartially analyzed and formulated after study and experiment into standards of practice for technical regulation of construction, installation, and operation, and based upon standards of measurement, quality, and performance. Collation of standard data, numerical magnitudes, and ranges of the pertinent factors defining quality, safety, economy, convenience and efficiency.

thorough technical consideration in advance of adoption if they are to be fair and effective. In some cases uniformity of practice is of great importance, and in any such case the work of the bureau is of particular value because of its national character. However, in most cases the work of this sort is limited to an advisory or consulting function regarding matters of scientific fact. Regulatory measures which are matters of opinion are, or should be, in the hands of state and city authorities or intrusted to other government departments. As a matter of fact, the Bureau of Standards has substantially no work of a supervisory or administrative nature. Its whole organization is based on the assumption that it will not have any such police powers, even with respect to matters of fundamental standards of weight and measure, much less with respect to any other matters of science, technology or industry.

Growth of Industrial Research

The adoption of standard specifications, the determination of standard constants and other work on industrial materials have naturally led to an interest in industrial research. In some lines the bureau has found that industry was wholly unable to supply it with information regarding industrial processes in relation to composition or quality of the product sold. This led to a desire for a study of the industrial processes themselves; and the bureau has installed textile, paper, rubber, glass and ceramic equipment that makes its large industrial laboratory virtually a small-scale industrial city. To a considerable extent this work has been done with funds furnished by Congress for specific purposes. For example, one fund of this sort was specifically provided for the investigation of textiles, another for the investigation of optical glass, a third for the study of clay products, and several others of more general significance for industrial research, metallurgical research, etc.

In many cases the bureau has been encouraged by the members of industrial establishments to carry out this small-scale commercial, industrial research. In other cases there has been some criticism of the bureau for this work. This criticism has apparently been based largely upon the claim that the bureau should do nothing of this sort which industry can do for itself, but should limit its efforts to fundamental studies of science, either pure or applied, which are of interest to many industries or to all parts of an industry that cannot afford to carry out this work without government aid.

There is no doubt that the industrial work of the bureau has been more conspicuous and for many reasons more attractive to many of the members of the technical and scientific staff. Naturally this type of work is best appreciated by Congressmen, and thus encourages Congress to grant appropriations for subsequent work. Probably for this reason there has been a marked increase in this type of study, which began to be noticeable during several years preceding the war. However, it has been felt that in some cases the tendency has gone so far as to supersede fundamental scientific studies with so-called "practical" or technical investigations. Where this has occurred, there has been ample ground for the objection raised by those who no longer could get from the bureau the expected assistance on *fundamental* scientific work which that institution alone can do to best advantage in some cases.

Aluminum Products in 1921

The Department of Commerce announces that the census reports show a considerable decrease in the activities of the establishments engaged in the manufacture of aluminum products during the year 1921 as compared with 1919. The total value of products reported for 1921 amounted to $45,822,000, and for 1919 to $75,278,000, a decrease of 39.1 per cent. An additional production amounting to $1,847,000 in 1919 was reported by establishments engaged primarily in the manufacture of other products, principally brass, bronze and copper products. Corresponding figures for 1921 are not available.

The returns indicate that the combined output of all establishments was approximately 50 per cent of the maximum capacity, based upon a demand requiring full running time.

The statistics for 1921 and 1919 are summarized in the following statement:

COMPARATIVE SUMMARY OF STATISTICS FOR ALUMINUM MANUFACTURES, 1921 AND 1919

	1921*	1919*	Per Cent of Decrease†
Number of establishments	87	83	....
Persons engaged in manufactures	11,018	13,257	96.1
Proprietors and firm members	36	34	....
Salaried employees	1,398	1,821	23.2
Wage earners (average number)	9,584	11,402	15.9
Salary and wage payments	$13,945,000	$16,634,000	16.2
Salaries	3,110,000	3,307,000	6.0
Wages	10,835,000	13,327,000	18.7
Contract work	9,000	11,000	18.0
Cost of materials	25,974,000	49,272,000	47.3
Value of products	45,822,000	75,278,000	39.1
Value added by manufacture‡	19,848,000	26,006,000	23.7

* Figures given for 1921 do not include establishments reporting products below $5,000 in value. Eight establishments of this class reported a total of four wage earners and products to the value of $24,000. The figures for 1919, however, include three establishments of this class, reporting no wage earners employed and products to the value of $7,000.

† Percentages omitted where the base is less than 100.

‡ Value of products less cost of materials.

The figures for 1921 are preliminary and subject to such change and correction as may be found necessary after a further examination of the original reports has been made.

Use of Steam in Coal-Gas Retorts

The tendency toward lower standards of quality of gas in public utilities has increased the interest of the gas industry in processes that promise to increase the yield of gas per pound of coal coked, even though attended by a decrease in quality. The introduction of steam during or at the close of the coking process has shown considerable advantage in certain types of gas-making installations, notably in vertical retorts. The Bureau of Mines has co-operated with the American Gas Association in studying the effects of using steam in horizontal retorts, which are commonly used. It was found that the method of admitting steam had much to do with the results obtained. Little, if any, water gas was generated by decomposition of steam in the retort charge, unless the contact between the steam and the charge was intimate. Steam as usually introduced in the small gas plant where the process has been tried has no advantage. With prevailing standards of gas quality, little advantage can be taken of the use of steam, even if properly applied, as the production of any appreciable volume of water gas considerably reduced the general quality of the total gas production.

Only very recently has the thermal standard come to be universally adopted in place of the antiquated illumination standard. Should standards be further reduced, this process might show more marked economies.

Shaping Management To Meet Developing Industrial Conditions*

An Analysis of Present Industrial Conditions—The Existence of a Buyers' Market for the Next Decade — How Management Must Change to Meet This Condition—What the Future Holds

BY H. S. PERSON
Managing Director, Taylor Society

IN THE conduct of any enterprise there is a major function, the responsibility for which resides somewhere in the organization, of determining future policy. In many enterprises this function may be regarded lightly, or even disregarded, on the principle that sufficient unto the day are the problems thereof; but in the larger enterprises, and in all well-managed enterprises of any size, it is not neglected. This is one reason for their good management.

The problem of future policy has many phases, of which the following come at once to mind: the commodities or services to be produced and sold; the quantities of these it is safe to attempt to produce and sell; the financial and technical equipment necessary; the technical methods of producing and distributing which shall be employed; the conditions of human co-operation which must be established in the enterprise. These, and many other major phases of policy not here enumerated, break down into numerous subsidiary but also individually important elements. The difficulty of solving the policy problem is not reflected in the simplicity with which these elements may be enumerated, for they are not clearly separable, but are complicated and cross-sect one another. Furthermore, solution of the policy problem requires measurements and estimates of elusive and changing governing conditions—the variable demands of markets for particular commodities and services; the variable strength of actual potential competition to meet these demands; the availability of financial and technical resources and changes in these; the availability of workers and the changing conditions of their co-operation; restrictions or regulations which may be imposed by governments, and so on. And thoroughgoing measurements and estimates of such things as these lead farther into the consideration of factors still more elusive; changes in the habits, tastes and mental attitudes of peoples; the probabilities of new discoveries and inventions; changes in the social machinery for the conduct of industrial operations; that complex of conditions generally designated by the inclusive term "industrial conditions."

What the American Executive Is

It is highly probable that an increasing number of enterprises will come to recognize that policy determination is a function which requires serious and continuous attention. It will involve the ascertainment of and analysis of facts concerning which executives have in the past had little interest, and it will involve, above all, much and careful thinking. It is questionable whether the American executive can be characterized as a thinking executive so much as one intuitional in reaction to immediate facts; he himself has been proud rather to consider himself the doer and go-getter par excellence—he who acts and gets while others think. If he is what he believes himself to be, he is the natural product of his economic environment; but one question to be raised tonight is whether there is not evident a sufficient change in the environment to make any such pride now unreasonable.

The particular phase of the policy problem which is to be considered tonight is presented in the question, "How must executives shape their managements to meet developing industrial conditions?" This question is fundamental, for a particular kind of management is an expression of decisions on many other matters of policy. The question is not to be understood as asking, "What new principles of management must be discovered and formulated to meet developing industrial conditions?" There are principles enough at our command—many more than have been generally recognized and utilized—to meet any conceivable conditions. We might change to a socialistic or communistic society and still be adequately served by the technical principles and methods already at industry's command. But under even moderately diverse industrial conditions we must utilize these principles and methods in different combinations, must weigh them differently, in accordance with the requirements of particular circumstances.

How Industrial Conditions Are Developing

Let us give our attention first to developing industrial conditions. A first glance is reassuring, for the revival due to follow the acute depression of 1921 is obviously already under way. This is indicated in all the reports of fundamental lines of activity. Bank clearings, car loadings, the production of basic commodities, and merchandise distributions have increased; stocks and bonds are more active; the spread between commodity prices has been reduced and in general a possible further long-run decline in commodity prices has been checked by price advances; there is an increase in employment and even in places a shortage of unskilled and skilled labor. Executives are reporting that they are "getting the red ink off their books"; and frequently there appear in the press optimistic utterances of captains of industry. We even already hear talk of a 1923 boom on the part of ultra-optimistic business men.

But a second, less superficial, consideration of conditions causes us to hesitate to join those who believe "it is all over except the shouting." May not this evidence of revival be only the evidence of rebound from the extreme depression, and may not the present rate of acceleration be only temporary, to be replaced by a rate more moderate? May not the projection of a curve into the future on the assumption of a continuance of the present rate of revival be a dangerous basis on which to establish managerial policy for the future? The more thoughtful and cautious fear so. When there is eliminated the activity to supply seasonal and terminable demand, and particularly the intensive activity to supply the abnormal demand for fundamental necessities to which the exigencies of war denied satisfac-

*Paper presented at a meeting of the Taylor Society, New York, Nov. 23, 1922.

tion—for instance, construction and all the lines of industry attendant on construction—when there is observed the fact that consumers' demand for a wide range of commodities and services is continuing to be hesitant and cautious, there is not left a sufficient amount of evidence to warrant a projection of the curve of industrial activity into the future at its present gratifying slope.

Consuming Public Has Cut Purchases

This point of view is expressed by a careful special correspondent of a dependable New York financial paper in a report from New England: "The only inference to be drawn [from facts enumerated] is that the bulk of the consuming public has been cutting off one thing after another in order to make its income go as far as possible in the matter of the commodities which it considers essential. Briefly, there are indications of a shrinkage in the American standard of living, which perhaps does not augur well for a long continuance of the present upward trend of industry, so called." How many in this audience have not reduced their standard of living from what it was during the period of 1914-1921, and how many, because of personal circumstances, do not expect to continue to keep it reduced for some time to come? The demand permitted by the aggregate of personal circumstances is what makes the market.

A third and more penetrating analysis, this time of more fundamental conditions, is even disconcerting to those who believe it is all over except the shouting. During the past decade, as a result of the study of earlier cyclic movements, we have learned that certain economic phenomena, such as the quantity of money and credit, have a definite relation to industrial activity. The store of money and credit influences prices and the price movement influences industrial activity. We should recall that the long period of accelerating industrial activity culminating in the frenzy of 1920-21 was coincident with a long upward swing in prices; that in general industrial activity increases in intensity with an upward price movement, is stagnant when there is a downward price movement, and is hesitant and uncertain in the early years of a new stable price level. Of course, the ideal condition is a fairly stable general price level, but when a condition of stable price level suddenly confronts an industrial generation which has become accustomed to a consistent upward price movement over a long period, the new condition of stability, because different from the accustomed, is upsetting to the individual, either as demander or producer, and it takes a considerable period, measured not in months but in years, for him to learn just what he can safely do both in purchasing and in producing.

Views of Harvard Committee

During recent years some sound work has been done in the analysis of fundamental industrial conditions and tendencies, which has given a basis for policy determination more substantial than anything we had previously had. It may be observed that during the past 3 years of experience wholly new to us the forecasts of these investigations have "called the turn" more accurately than the prophecies—or guesses—of business men. These investigators have succeeded in making some accurate measurements of basic elements which determine price conditions for a number of years ahead, and the safest judgment to accept is that, in the words of the Harvard Committee on Economic Research, "the present price level is substantially that around which the fluctuations of the business cycle must play" for the next 10 years. I make my own private reservations to that broad statement, for I believe the committee has failed to take into consideration the capacity of American managerial genius to increase vastly, when put to it under intensely competitive conditions, the quantity of goods for exchange which may be produced from a given combination of plant, equipment, materials and labor; but perhaps the committee is wise in not taking that into consideration, for it depends upon the wills of owners and managers, who are a conservative group when it comes to the adoption of new production methods.

Assuming that forecast to be correct, what is likely to be the effect of a new, high price level "around which the fluctuations of the business cycle must play"? Simply that you and I are, for a number of years, going to continue to be conservative as purchasers, and also conservative as producers. As producers we are going to wait for demand, and as demanders we are going to wait until we have adjusted our purchases to the new relation between our incomes and the cost of living. It is true that wages are settling at a new high level, but there still remains a large number of consumers whose incomes are not readjusted so easily and quickly, whose incomes as at present and will for some time continue to be adjusted rather to the old price level, and it does not take a very large bloc of maladjusted consumers to keep the market unsteady and uncertain.

The Market for the Next Decade

The conclusion I would have you draw is that for, say, a decade, consumers' demand is likely to remain so hesitant and uncertain as to be out of proportion to our capacity to produce. It does not seem necessary for me to give this particular audience any proof that the war has disclosed that our capacity to produce far exceeds anything we had believed it to be. I have talked recently with observing men who have covered the country from Maine to California, and they have reported that the most impressive single fact of their observations is the tremendous capacity of American industry to produce. You will recall President Friday's address at a meeting of this society two years ago; he stated that one outstanding fact is the increase in our productive capacity during recent years, and that if the war has taught us anything, it is that we allow a large part of that capacity to "run to waste through sheer idleness." Now I put this question to you as practical managers: If our productive capacity is so great, and if it can be made much greater simply by eliminating sheer idleness, and if consumers' demand is fairly certain to be hesitant for the coming decade, have you or have you not a really critical management problem?

However, before considering the kind of management that problem is going to force upon you, I want to make one more, a fourth, analysis of present industrial tendencies, painting the picture upon a large canvas. Let us give the picture a striking American title: The Overland Trail—from a dominant sellers' market to a dominant buyers' market. We all appreciate that we are now in at least a temporary buyers' market; I am suggesting that we are on the trail to a dominant buyers' market, and that we are possibly already on the great divide. If we are, we shall learn to manage our enterprises differently.

A summary review of the industrial history of the United States should make it patent that we have been brought up in a sellers' market. We have been pioneers—explorers, appropriators and exploiters of a vast continent of extraordinary resources. It has been a California of '49, or a Klondike, on the scale of a continent and a century. The exploitation of resources which have always had an immediate world market and cash value, the appropriation of stores of capital and treating it as income, has given our population a geometrically increasing purchasing power. Consumers' demand has kept ahead of and pulled along producers' capacity to satisfy the demand.

A Buyers' Market

But there comes a time in the history of an appropriating and exploiting people when they cease to be frontiersmen and appropriators; when the stores of nature's wealth are uncovered and appropriated, when future income through exploitation is capitalized at current values, when income becomes real income derived from productive effort and ceases to be in large part the appropriation of capital resources; when there emerges on the one hand a class of *rentiers* and on the other hand a larger class of laborers, clerks, sub-executives, major executives, merchandisers and others whose income is, on the whole, limited by the productivity of their efforts and whose consumers' demand power tends to become correspondingly fixed. In other words, industrial society tends to become more stratified and stable. There is then the danger of a period of maladjustment when technical equipment and productive capacity have overreached immediate demand, and when, if other markets are not sought, a buyers' market succeeds a sellers' market as the dominant factor in the industrial situation.

There were signs before the war that the industrial development of the United States was approaching that stage of evolution. Natural resources had become pretty well appropriated and capitalized—not only such resources as mines, forests and natural transportation routes, but also agricultural lands, for there was before the war an increasing proportion of tenant farmers, paying rent in cash or shares. Serious students were concerned over this tendency. Technical productive equipment was at the same time greatly increased, and there was no sign of a plan or even a clear intent to develop foreign markets. President McKinley's turn, just before his death, toward a reduction of the tariff obstacle to the development of foreign markets made no impression on the dominant political party, and there continued a period of tariff policy which has culminated in the Fordney-McCumber bill. It seemed to thoughtful observers that the quarter century before the war was a period of conscious or unconscious eat, drink and be merry, for today we are getting ours and tomorrow will take care of itself.

War Hastens Market Evolution

Then came the war, which was a tremendous shock to the industrial system. On the one hand it caused a still greater development of productive capacity, financed out of future earnings through the mechanism of bonus and taxation, and caused a coincident decline in consumers' demands (the frenzy of 1920 was but an unsubstantial flare-up), a decline which is likely to continue for some time because of the continuing heavy taxes and the maladjustments caused by the war. In short, the shock seems to have hastened evolutionary tendencies which would have developed more gradually and with only relatively minor depressions, and to have thrown us suddenly upon a buyers' market which will last for some time and may be the beginning of a dominant buyers' market.

What a Buyers' Market Means

A buyers' market means, for industries that are not competitive, a more radical and restrictive control or regulation, for when buyers look long at the dollar before parting with it, they look longer at the conditions which create the necessity for parting with all of it; and it means, for competitive industries, a strife for the consumers' dollar which makes so-called competition on a sellers' market seem but a children's game. In view of all these considerations, I think you will agree with me that there was never a time when management should have more concern over future policy—and over the quality of its future management.

Management on a buyers' market is quite a different thing from management on a sellers' market. On a sellers' market selling is but order-taking; on a buyers' market it must be real merchandising. On a sellers' market production is but the hasty and wasteful process of giving material things a form or other quality which will satisfy insatiable and not overcritical demand; on a buyers' market it must be more precise and economical. On a sellers' market financing is largely borrowing on the assumption of unexploited natural resources or an unexploited upward market; on a buyers' market it is a borrowing on demonstrable future earned profits. On a sellers' market the conduct of a business is easy and management is simple—in fact, there does not have to be any real management. But now that you appear to be face to face with a buyers' market and the necessity of developing real management, if you are to be successful in a most intense competition, if your competitor, instead of yourself, is to be the one to disappear in some readjustment of productive capacity to consumer demand, it is expedient for you to inquire into the nature of that real management.

The Problem Involved

The essential practical elements of the problem confronting that management may be summed up as follows: On the side of supply there is a tremendous production capacity involving heavy investments of capital in more or less specialized equipment, to preserve the value of which will require a continuation of the lines of activity for which it was designed. On the side of demand there is a conservative and hesitant market—in fact a buyers' market—which will continue for a considerable period. This will mean intense competition on the part of management to find the individual consumers and to sell them. In that competition selling price and cost of production will be critical factors. The hesitant market will tend to force selling price down, while higher prices of certain elements entering into cost will tend to keep that figure up.

The fact cannot be disregarded that, as was the experience after both of our earlier great wars, wages have settled at a new high level, and that the strength of organized labor and new immigration policy seem sufficient to hold them there during such a period as will determine the success or failure of competing enterprises. It should be observed also that many of the basic materials of industry are more or less closely

controlled, and that material costs are likely to remain high. Therefore management will be faced by high prime costs in the face of great pressure to reduce the selling price of fabricated products. The way out for the successful competitor appears to be this: to develop an inclusive system of management which will more than compensate for high prime costs by cost savings elsewhere, thereby effecting lower factory costs and making possible lower selling prices or making possible a higher quality of product at the original cost and selling price.

In the first place that management will give more attention to such problems as we are considering tonight—long-run tendencies in the industrial environment. These matters will no longer be regarded as merely "theoretical"; they will be regarded as very practical. Certain major executives will give more thought to policy and general plans, and not permit themselves to become too much absorbed in operating details and worn out by late afternoon worries. They will not confine their reading to the news headlines and market quotations of newspapers, but will read under the headlines, search for the facts and do some thinking of their own. They will find time for—and consider as important as some of the things for which they now find time—the reading of magazines of fact and opinion relating to administration, management, economics, politics and industrial relations. They will have in their organizations a unit to study and interpret industrial statistics. In illustration, a major executive of a certain medium-sized plant inquired of the Taylor Society the other day where he could find a young man, a college graduate trained in economics and statistics, to study for him the periodic reports of statistical service, and interpret them for the management in terms of the particular business. That enterprise is getting the jump on competitors.

Managers Must Study Markets

That management, in the second place, will provide for a more accurate judgment of the market with respect to the demand for the commodities it has to offer, competitors' ability to supply the demand, and what share of the market it can have reasonable expectation of securing. It is with the consumer that the impulse for industrial activity begins—"the consumer is king"; but on a sellers' market consumers are so numerous and insistent that we forget the source of the impulse and come to believe that it starts with the producer. Under the competitive conditions of a buyers' market, managers will see that in true perspective. Managers will learn that they cannot afford to misjudge demand, either with respect to what it wants, how much of that it wants, or what share of it competitors will permit a particular enterprise to provide. Excessive inventories are fatal on a buyers' market. An enterprise must avoid that by some unit of the organization, whether it be an individual or a group, which will make continuous and precise analyses of the market and provide the data for master plans and schedules. Call it what you will—market research, merchandise research, sales engineering.

In the third place, that management will set up in writing, on the basis of the data secured by market research, definite master plans, budgets and schedules of operations for a considerable period ahead, these being supported by definite and interdependent detail plans and schedules for the major operating departments—selling, production and financing, respectively. These master plans and schedules, and these supporting departmental plans and schedules, will be standards of performance, goals to strive for, lines to which to hew. To do without such plans and schedules means guessing, taking chances, departments out of alignment, unbalanced inventories, higher costs—losses for which the consumer willingly pays the price on a sellers' market, but which, on a buyers' market, become a loss to the producer which he cannot afford when competition is intense.

That management, in the third place, will have to conduct its selling operations with more skill than it has ever displayed before. On a sellers' market the consumer seeks the producer; on a buyers' market the producer must search out the consumer and sell him, in the midst of a keen competition both of other producers of the same commodity and other uses of the consumer's dollar. Just as there must be no misjudgment of the market, lest there be unsold inventories; no failure to make precise plans and schedules, lest there be unsold inventories; so also there must be no failure to search out and sell to the estimated number of consumers, or there will be unsold inventories.

Changes Caused by Buyers' Market

Are we able to imagine the detail changes which are likely to follow the development of the new merchandising? Is it not probable that there will be less of that advertising whose object is to create new wants in satisfaction of which consumers would spend surplus dollars, and more of that advertising whose object is to convince concerning the quality of staple merchandise offered in competition for the limited supply of dollars? Will not the work of salesmen be something besides either mere order-taking or mere psychological suasion; is not the salesman more likely to spend more time searching out prospects; calling on prospects as well as established customers; skillfully displaying the merits of goods; rendering intelligent—even scientific—service; planning and scheduling his work? Will not the supervision of sales executives and their assistants be more comprehensive and more skillful—again, more scientific—than anything we have seen; salesmen better selected, better trained, their work better planned and scheduled and given more intelligent and effective support by the directing staff? Will not the channels of distribution be more carefully studied and more discriminately selected?

I have called attention first to market analysis, master plans and budgets, and selling, as conspicuous features of the new management, not because they are superior in importance to other phases of management, but because they logically come first—the point of origin from which to lay out the operations of an enterprise being the consumer—and because in the sellers' market of the past these phases have been most neglected. It is not to be assumed, however, that I attach less importance to better production methods as a feature of the new management.

Good Production Methods Necessary

There are some who assert that the production problem is solved and that we should now give most attention to other phases of management. I believe they are too hasty in their judgments, especially if we are thinking in terms of a severe competition on a buyers' market. The production problem is far from

solved. It is true that we know more about good production management than about good sales management, and that we have a body of production management principles and practices at our command which, if utilized, would eliminate waste, reduce factory costs and permit price reductions to an astonishing extent; but it is equally true that they are not generally utilized, and the educational task of bringing about their utilization in a plant is as difficult and time-consuming a task as developing market analysis and improved selling methods. Perhaps more so, for the development of market analysis, master planning and selling is the problem of a small group of specialists, while the development of superior production methods is a problem involving the precise co-operation of many individuals of varying capacity for co-operation.

Furthermore, the more severe the competition the more important become good production methods. For in the final analysis, no matter how accurately we gage the market, how precisely we prepare schedules of operations, how skillfully we sell, the greatest weapon in competition is the combination of a dependable product, a dependable service and a quotation lower than competitors', and it is superior production methods which contribute most to making this weapon possible. If you can safely and consistently quote a lower price for an identical commodity and have a reasonably good selling organization, your competitors will hold you in dread.

Waste Must Be Eliminated

In the fourth place, therefore, the superior management of the next decade will develop the production department to a high degree of precision, in accordance with principles and methods already formulated and available. As some strong merchandisers secure their profits by taking discounts, so strong manufacturers can take their profits by eliminating waste—the waste of useless or unused plant; the waste of useless, unused or inefficiently used equipment and tools; the waste of unsuitable, inadequate or lost materials; the waste of inefficient methods; the waste of improperly chosen, improperly assigned, improperly instructed and inadequately inspired workers. Investigations and experiments will be conducted which will disclose the best equipment, tools, methods and materials for the fabrication of the product, and on the basis of the discovered best details will be established standards of product, equipment, materials and processing. Provision will be made for the maintenance of these standards, and these once established and maintained, a control of operations through planning, scheduling and checking of progress will be possible, which, as has been demonstrated in too few but an adequate number of instances, forges the competitive weapon of lower costs and lower quotations.

Finally, that management will win the co-operation of all the personnel of the enterprise, not as a matter of humanitarianism but as a matter of technical necessity. Without such co-operation all other provisions for excellence of management are impaired. The good will of the personnel is in many instances the determining factor in successful competition. The combinations of elements by which this good will is won may be different in different enterprises, but all will be identical in at least two respects: a group of elements which secure the personnel's cordial consent to the standards of all kinds which are established, and a sharing of the product of combined effort through wages which satisfy the personnel as reasonable and just.

The entire personnel of an institution, from major executive to the latest recruit, should be a co-operating group of individualities—co-operating, in the sense that each must play a part in a system of operations; individualities in the sense that each should be an original source of inspiration and new ideas and a creator of new methods which fit and promote the work of the system. Too many institutions simply inbreed. Individuals lose their individuality and the organization loses its vitality. The greatest asset of an organization is not plant and equipment, cash in the bank, or even an organization of persons; but a spirit of co-operation, an atmosphere of live interest in the best management principles and practice, an *esprit de corps* of search for wiser policies and better methods and individualities which have not lost the power of creation within co-operation.

It is not out of place to call attention to a special aspect of the new management—the utilization of a new type of executive. The long sellers' market of the United States has developed highly one particular type of executive—the forceful, acquisitive, go-getter type which drives straight to results regardless of methods and cost. But while the forceful, go-getter type of executive will always be essential, managers have come to realize that an organization must be balanced by the inclusion of the thinking, investigating, planning type of executive who surveys conditions and tendencies, formulates precise plans, establishes schedules and budgets, keeps departments co-ordinated, maintains precise control of operations, has regard for efficiency and economy of methods, and all the time appraises progress and results in terms of plans. Even the go-getter executive must become a thinking, planning executive after the enterprise is well established as a going concern. The thinking and planning type of executive will play a decidely important part in the future.

What the Future Holds

In conclusion, it should be understood that I am not pessimistic concerning what I believe is likely to be the developing industrial conditions. At the worst, consider what has been said as a word of warning. In the long run our very capacity for production will solve the problem, as it has in the past solved it under comparable circumstances; but the restorative power of that capacity for production must be realized chiefly through a regulation by better individual managements. We shall have short-time cyclic variations but fundamental increasing prosperity for industry in general during the decade of correction of maladjustments to new conditions. Note, however, the significance of the words "for industry in general." In the probable readjustment through competition on a buyers' market, some enterprises are certain to disappear, and they will be those particular enterprises which are satisfied with the management which is "just as good as the average," for that mental attitude almost invariably means managements which are poorer than the average. For a quarter century before the war even poorly managed enterprises were helped in their ascent to the heights of prosperity by the escalator of a sellers' market; now that escalator is out of commission, and the ascent to new prosperity must be achieved in the good old fashioned way—by good management muscles, good management lungs and good management brains.

Two Forms of Nitrogen in Steel

BY LOUIS JORDAN AND F. E. SWINDELLS
Chemist and Assistant Chemist, Bureau of Standards

WHEN heat-treating two heats of silicomanganese spring steel it was found that certain hardening treatments very noticeably increased the combined nitrogen in one steel made in an electric furnace,[1] while an open-hearth steel of almost identical composition showed practically no increase in combined nitrogen.

The manufacturer's analyses of these steels for the usual constituents gave the following results:

	C	Mn	P	S	Si
Steel A (electric)	0.53	0.77	0.022	0.014	2.09
Steel B (open-hearth)	0.54	0.77	0.017	0.022	2.03

Analyses of the rolled stock as received by the bureau showed in the electric steel twice as much combined nitrogen as in the open-hearth steel (Table I).

TABLE I—COMBINED NITROGEN IN SPRING STEELS AS ROLLED

Electric Steel		Open-Hearth Steel	
Sample No.	Per Cent Nitrogen	Sample No.	Per Cent Nitrogen
A16	0.0041	B29	0.0019
	0.0051		0.0022
A2	0.0038	B1	0.0025
	0.0047		0.0031
	0.0051		
Average........	0.0046	Average.......	0.0024

Further analyses were made on samples of steels A and B which had been given (1) a regular hardening treatment, as practiced by spring manufacturers, (2) a normalizing quench followed by the regular hardening treatment, (3) a sample of steel A which had been subjected to the normalizing quench only. In the "regular" treatment, (1) above, a hardening temperature of 900 deg. C. (1,650 deg. F.) was used. The normalizing quench (2) was from a higher temperature—namely, 980 deg. C. (1,800 deg. F.).

Combined nitrogen in the open-hearth steel was changed but little if at all by the treatments given. However, either a normalizing quench or a normalizing quench followed by the regular treatment doubled the amount of combined nitrogen in the electric steel (Table II).

TABLE II—INFLUENCE OF HEAT-TREATMENT ON COMBINED NITROGEN IN SPRING STEELS

Treatment	Electric Steel			Open-Hearth Steel		
	Sample No.	Per Cent Nitrogen	Average	Sample No.	Per Cent Nitrogen	Average
As received...........			0.0046			0.0024
Regular hardening treatment..........	A4	0.0065		B2	0.0037	
		0.0068	0.0066		0.0023	
					0.0024	0.0028
	A5	0.0061				
		0.0064	0.0063			
Normalising quench...	A20	0.0098				
		0.0086	0.0092			
Normalising followed by regular treatment.	A31	0.0109		B19	0.0025	
		0.0095	0.0102		0.0035	0.0030

It is difficult to believe that the heat-treatment itself as carried out could increase the total amount of nitrogen in the electric steel and make no change in the open-hearth steel treated simultaneously. It seems probable, in view of the limitations of the solution method for nitrogen explained in a previous article,[2] that there is no increase in the total nitrogen in the steel, but that some nitrogen that was originally present in some form not determined by this method was converted into a form that permitted its determination.

Of interest in this connection is a patent granted to Krupp Akt.-Ges.[3] which has claims based on the introduction of nitrogen into steel at temperatures below 580 deg. C. in the form of solid solution, as distinct from nitride of iron which is formed on heating above that temperature.

ELECTROLYTIC IRON TREATED WITH CALCIUM

A series of ingots of electrolytic iron was next examined to determine if similar changes in combined nitrogen could be detected in iron free from the usual metallurgical impurities or alloying elements. These ingots had been prepared for another purpose and to all but one (ingot 385) small amounts of metallic calcium had been added just before casting in a chilled mold. Melting was done in a high-frequency induction furnace in crucibles made of 85 parts of magnesia and 15 of zircon. Combined nitrogen was determined in these ingots as cast. They were then given a heat-treatment similar to the treatment which gave the greatest increase in combined nitrogen in the electric furnace spring steel—namely, a normalizing quench from 1,040 deg. C. (1,900 deg. F.) followed by a second quench from 910 deg. C. (1,670 deg. F.). Table III shows that there was nearly always a marked increase in the combined nitrogen. Four of these treated ingots were annealed at 950 deg. C. (1,740 deg. F.) for one-half hour and then cooled slowly over a period of about 4 hours. No very definite change in the combined nitrogen was caused by this treatment—the slight differences observed were not uniform in direction.

TABLE III—COMBINED NITROGEN IN ELECTROLYTIC IRON INGOTS TREATED WITH CALCIUM*

Ingot No.	Per Cent Nitrogen As Cast	Average	Per Cent Nitrogen After Heat-Treatment	Average	Increase Due to Quenching	Per Cent Nitrogen After Annealng	Average
380	0.0087		0.0111			0.0126	
	0.0082		0.0101	0.0106	0.0018	0.0112	0.0119
	0.0096	0.0088					
381	0.0015		0.0029			0.0029	
	0.0030	0.0022	0.0037			0.0032	0.0030
			0.0051		0.0022		
			0.0059	0.0044			
382	0.0030		0.0050				
			0.0054	0.0052	0.0022		
383	0.0015		0.0040				
			0.0042	0.0041	0.0026		
384	0.0028		0.0042			0.0042	
			0.0037		0.0011	0.0030	0.0036
			0.0037	0.0039			
385	0.0016		0.0036			0.0024	
			0.0038	0.0037	0.0021	0.0021	0.0022

* The calcium added was equivalent to 0.2 per cent in 380 and 381; 0.1 in 382; 0.03 in 383; 0.01 in 384. No addition was made to 385. The residual calcium in the ingots ranged from 0.04 to 0.003 per cent.

AUTOCLAVE STEEL

There was next examined a specimen of steel from an autoclave used for containing the catalyst and nitrogen-hydrogen gas mixture in the Haber process for nitrogen fixation. The gas mixture in this autoclave was treated at a pressure of 1,500 lb. per sq.in. and at a temperature of 500 deg. C.

	C	Mn	P	S	Si
Outside layer....................	0.42	0.65	0.031	0.033	0.29
Inside layer.........................	0.14	0.65	0.032	0.036	0.29

Published by permission of the Director of the Bureau of Standards, U. S. Department of Commerce.

[1]H. J. French and L. Jordan. Discussion of paper by MacQuaid and Ehn. Paper No. 1163 issued with *Mining & Met.*, May, 1922.

[2]"Determination of Combined Nitrogen in Iron and Steel," by Louis Jordan and F. E. Swindells, *Chem. & Met.*, vol. 27, No. 23, p. 1135, Dec. 6, 1922).

[3]F. Krupp Akt.-Ges., Brit. Pat. 174,580; *Chem. Abs.*, vol. 16, p. 1738 (1922).

Analyses of the inside and outside layers of the plate for the usual elements showed considerable decarburization of the inside layer.

Nitrogen determinations showed that the inside contained about 50 per cent more combined nitrogen than the outside. One sample of this plate was given the regular hardening treatment previously referred to in the case of the spring steels and another sample the normalizing quench followed by the regular treatment. There was a very marked increase in the combined nitrogen in the outside layer with both heat-treatments. In the inside layer there was no change in the combined nitrogen. (See Table IV.)

TABLE IV—COMBINED NITROGEN IN AUTOCLAVE STEEL

	As Received Per Cent Nitrogen	Average	Regular Treatment Per Cent Nitrogen	Normalizing Followed By Regular Treatment Per Cent Nitrogen	Average
Inside	0.0145		0.0145	0.0146	
	0.0140	0.0142		0.0156	0.0151
Outside	0.0091		0.0162	0.0149	
	0.0093	0.0092		0.0128	0.0138

The failure of the combined nitrogen of the inside layer to be altered by heat-treatment may possibly be explained by the fact that the conditions of service (namely, at 500 deg. C. in the presence of hydrogen and nitrogen under pressure) were such that all the nitrogen, both originally present and diffusing into the plate, was converted during the operation of the autoclave into the form determined by the solution method. The outside layer of the autoclave plate was possibly at a lower temperature than the inside layer, a temperature below that necessary to convert to the nitride form the nitrogen diffusing from the interior.[4] A still more probable explanation is that the presence of hydrogen was necessary to cause all the nitrogen to form nitrides and that the outer layer of the plate was beyond the zone of hydrogen penetration, a fact indicated by the decarburization being limited to a narrow inner layer.

Fused Electrolytic Iron

An attempt was then made to check the previous results obtained with the electrolytic iron. Three ingots of electrolytic iron were prepared in a high-frequency induction furnace and cast in a chilled mold. One was melted under quiet air in a crucible of 85 parts of magnesia and 15 parts of zircon. The two others were melted in pure magnesia crucibles, one being under quiet air and the other under a stream of pure nitrogen. These ingots were given the same heat-treatment as the first electrolytic iron series—viz., a normalizing quench followed by hardening. No change in the combined nitrogen could be detected (Table V).

TABLE V—COMBINED NITROGEN IN ELECTROLYTIC IRON

Ingot No.	Method of Preparation	Per Cent Nitrogen As Cast	Average	Per Cent Nitrogen After Heat-Treatment	Average
388	MgO-zircon crucible; under air	0.0033		0.0031	
		0.0030	0.0032	0.0030	0.0030
456	MgO crucible; under air	0.0033		0.0034	
		0.0056		0.0034	
		0.0056	0.0048	0.0030	0.0033
457	MgO crucible; under nitrogen	0.0070		0.0071	
		0.0072	0.0071	0.0065	0.0068

It is improbable that the observed increase in combined nitrogen in the above metals is due to nitrogen introduced during heat-treatment, since the electric and open-hearth steels were treated simultaneously, as were also both layers of the autoclave plate. The increase was found in one member of each pair but not in the other. In other words, the total nitrogen in these metals was not increased.

It is likewise improbable that the increase in nitrogen determined by the Allen method is due to the formation of iron nitride following the decomposition of nitrides not determined by this method of analysis, since this increase in combined nitrogen also took place in the first series of electrolytic iron ingots, which contained as the only impurity mere traces of calcium, the nitride of which is readily decomposed by acids.

It is to be concluded that nitrogen may be present in iron and steel in more than one form—as combined or nitride nitrogen and as uncombined nitrogen. The changes in the amounts of combined nitrogen are probably the result of conversion of free or uncombined nitrogen to nitride nitrogen. The free or uncombined form of nitrogen is not present in all samples of iron and steel, or may vary widely in amount.

The authors wish to acknowledge their indebtedness to H. J. French for carrying out heat-treatments of the metals examined and to H. A. Bright for making the chemical analyses other than those for nitrogen.

[4]Compare the claims of the Krupp patent, note 3.

Spanish Trade in Chemicals

Before the war Spain imported from abroad a great part of the chemical products employed by her industries, especially coloring matters derived from coal.

From the point of view of tonnage landed in Spain, the first rank was taken by superphosphate of lime and basic bessemer slag; then the following products may be quoted as having given rise to a good current of business: Vegetable preparations for the dyeing industry, vegetable preparations for medicinal purposes, coloring matters, sulphur (raw and refined), alkalis, insecticides and sulphate of copper, feculas for industrial purposes, gums, dextrine, etc., for stiffening purposes, paraffine and nitrate of soda.

Germany despatched approximately 25 to 30 per cent of the importations of this class of goods; Great Britain 20 per cent; the British possessions in Asia 12 to 15 per cent; the Dutch colonies 6 to 7 per cent (the two last-named regions sent principally oilseeds), while France's share of this trade amounted to between 10 and 12 per cent.

During the war the Spanish industry, finding itself mistress of the home market, equipped itself to supply a considerable number of products of which the importation had ceased; for example, arrivals of dyestuffs derived from coal fell from 1,351,058 kg. in 1914 to 406,342 kg. in 1917. This industry consequently insisted on a high customs tariff.

It seems that the commercial conventions inaugurated during the past 6 months will facilitate to a certain extent the importation of chemical products into Spain, but the final result cannot yet be foreseen.

It appears that in the case of some articles foreign industries must face a diminution of their sales in Spain, unless a great difference in the cost price can be attained. The manufacture of sulphuric acid and nitric acid has greatly developed in Spain.

The Minister for War intends to buy a large piece of ground (700 hectares) in the neighborhood of Madrid for the purpose of erecting chemical works with annexes in order to be able to manufacture products required for national defence now purchased abroad.

Gasification of Ohio Coals—I

The First of Two Articles Presenting the Results of a Preliminary Survey Made to Determine Suitability and Economic Value of Various Ohio Coals for Gas-Making Purposes

BY D. J. DEMOREST
Professor of Metallurgy, Ohio State University

THE natural gas production of Ohio has dropped so far below the demands of that state that out of the total consumption of 145,000,000,000 cu.ft. in 1920 Ohio produced only 60,000,000,000 cu.ft., the difference being made up by gas piped in from West Virginia. The new wells drilled in Ohio all come in with lower pressure year after year. It is obvious that the natural gas supply will grow less with each year and will soon be entirely inadequate for the state's needs even with gas from West Virginia.

These facts were so evident several years ago that it became a matter of immediate importance to institute a survey to determine what resources the state possesses for the making of manufactured gas to supplement and ultimately completely to supplant the natural gas. The writer presented the case to the Engineering Experiment Station of the Ohio State University and the Legislature was asked to appropriate a sum sufficient to erect an experimental plant whereby the gas- and byproduct-making values of the coals of Ohio might be determined. The Legislature made such a grant to the Engineering Experiment Station, out of which $10,000 was allocated for this coal-testing work to cover the cost of erecting the plant. The gas and coal interests of Ohio were then asked to appropriate funds for operating the plant for one year. The Southern Ohio Coal Operators' Association through W. D. McKinney, its secretary, made a grant of $200 per month for one year and the Gas and Oil Men's Association through W. H. Thompson, its secretary, granted $100 a month for one year.

THE PURPOSE OF THE SURVEY

It must be distinctly borne in mind that the researches reported in these articles constitute only a preliminary survey. It is hoped and expected that this preliminary survey will enable us to classify our coals so that we shall know which ones to select as the most economical for gas making, and then concentrate more detailed work upon those coals in order to discover exactly the best conditions for their gasification and to establish with a fair degree of accuracy their economic values to the gas industry.

Each coal yields its best value upon gasification under its own peculiar conditions. For instance, some coals must be gasified at comparatively high, others at comparatively low temperatures. The amounts of gas made, the total number of heat units in the gas, the number of heat units per cubic foot, the amount and nature of light oils recoverable, the amount and nature of the tar produced, the amount of ammonia recoverable, the impurities in the gas (such as hydrogen sulphide and naphthalene) and the quality of the coke all vary with the rate of gasification and the temperature. The amounts and qualities of these products which can be recovered also vary with the fineness to which the coal is crushed before charging in the retort and with the amount of moisture in the coal. It is also true that many coals which are not economically gasified alone may be very valuable for gasification purposes when mixed with a characteristic amount of some other coal.

In this preliminary survey it was possible only to carry out the carbonization experiments at the average temperature of 1,000 deg. C., which will probably give the best results for some coals but is too low a temperature for some other coals and possibly too high for still others. Furthermore, it was not possible in this preliminary survey to discover the optimum fineness for crushing nor to attempt to find the results obtainable by mixing coals or regulating the moisture content. In the further work which is to be done on certain selected coals, the economies resulting from steaming the coals and resulting from the use of sized coal will be ascertained.

In this work it was realized that the most highly refined methods for determining the benzol yield and the distribution of sulphur in the gas were not justified,

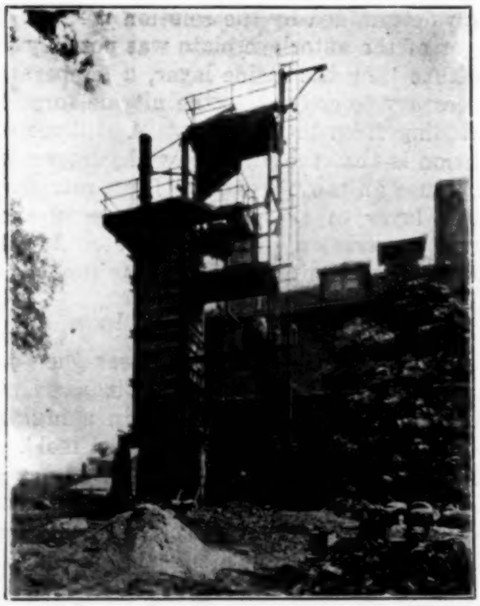


FIG. 1—FRONT VIEW OF RETORT STRUCTURE

because of the fact that in the preliminary work the time and money were not available for ascertaining the retort conditions which would give the best yields for each coal. Hence only comparative results were sought.

It is believed, however, that the results obtained from this preliminary survey are reasonably accurate and afford a basis for the selection of those of our coals upon which further detailed work should be done. Furthermore, they give a rough evaluation of all the coals for gas making.

The retort selected for gasifying the coal is an intermittent vertical type of exactly the same shape and dimensions as those in commercial use. In fact, the retort erected was an extra one of the 250 retorts

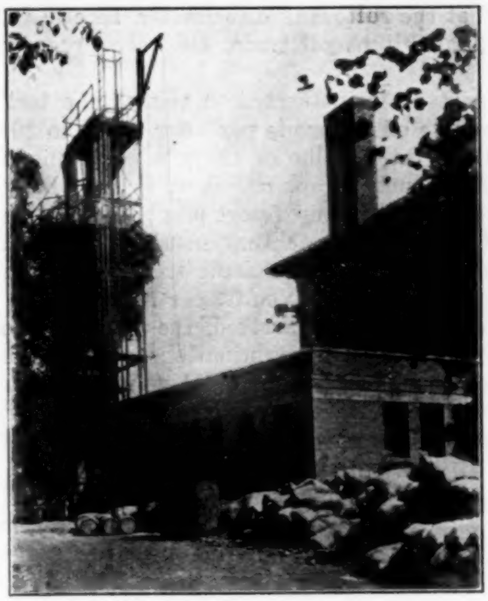


FIG. 2—SIDE VIEW OF RETORT STRUCTURE

erected at Rochester, N. Y., for the city gas supply. The United Gas Improvement Contracting Co., which erected the Rochester plant, also erected this experimental retort, generously doing it at cost.

The equipment required for recovering tar and ammonia from the gas made and the arrangement of machinery were designed in the department of metallurgy and erected by university mechanics.

The equipment for crushing the coal, washing the coal and testing and analyzing the products made are all a part of that possessed by the department of metallurgy.

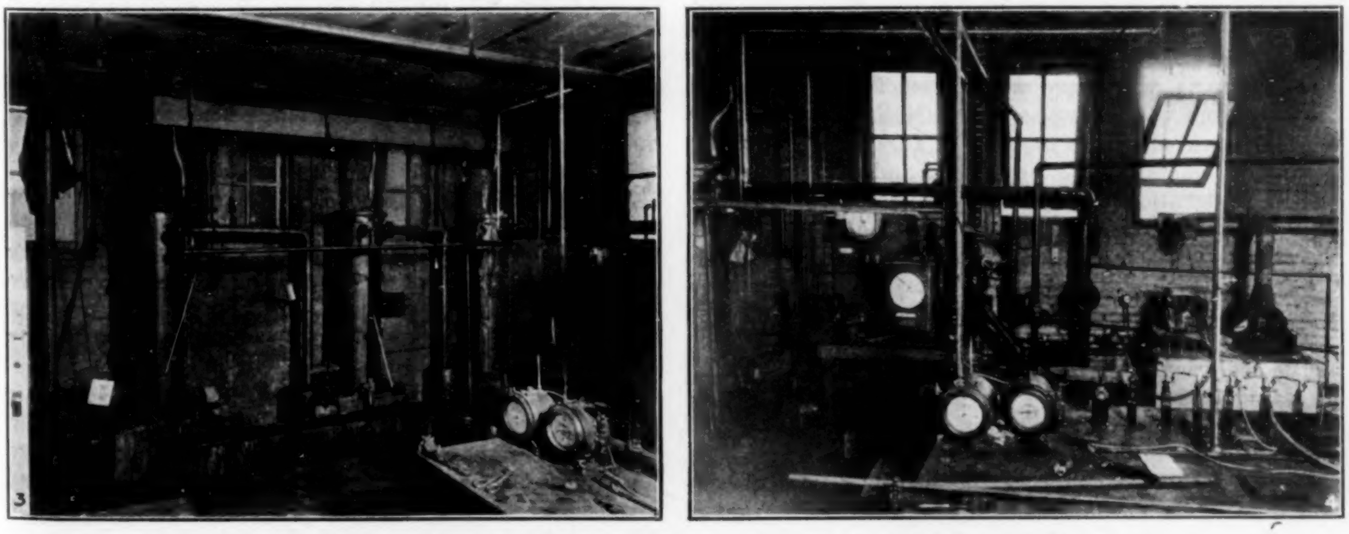
Figs. 1 and 2 are photographs of the retort structure and Figs. 3 and 4 are views of the byproduct recovery system. Fig. 5 is a diagrammatic sketch of the plant.

The retort carries a standard charge of 1 ton (2,000 lb.) of coal. The charge is all run in a fraction of a minute, and remains in the retort until the carbonization of the entire ton is complete, requiring 10 to 17 hours. In other words, the retort is of the intermittent type of vertical retort—not of the continuous type. The retort is heated for convenience sake with natural gas, burning at three different levels and giving an exceedingly uniform temperature around the entire setting. The temperature of the setting was recorded by a Brown recording pyrometer with the thermocouple halfway between the top and bottom of the retort. The thermometer was checked by a standard thermocouple and an optical pyrometer and was found to be correct.

The gas passes from the top of the retort *A* (see Fig. 5) through the bridge pipe *B* into the foul main *C*, thence down pipe *D* into the bottom of and up through scrubbing tower *E*, thence into the bottom of and up through scrubbing tower *F* and similarly through tower *G*. From tower *G* the gas is drawn through the exhauster *H* and to the furnace *I*. By means of the pump *J* a dilute sulphuric acid solution is continuously circulated through towers *E* and *F*. Cold hydrant water passes down through tower *G* and through the cooling coils *Z*, thence to waste. The cooling coils keep the circulating acid from becoming too warm. These scrubbing towers are filled with wooden grids staggered so that the gas and circulating liquids must come into intimate contact. The circulating acid solution removes all the ammonia from the gas and practically all of the tar not previously condensed. At *K* some gas is drawn off continuously for the determination of sulphur; at *L* the gas is sampled continuously for its "light oil" contents; at *M* a sample is continuously drawn for the determination of the B.t.u. value of the gas by means of a Smith continuous recording gas calorimeter, and at *N*, the gas is metered by a Bailey orifice gas meter, which continuously records the rate of gas making and integrates the total volume made.

The bottom of the retort setting is a heavy iron casting with an opening the size of the interior of the retort. This opening is closed by a cast iron door, *DD*, which is hollow and which is aligned with a channel in the iron bottom plate so that the tar which drips down against the door may drain out into tank *S*. The door is lifted into place before charging the coal and lowered for the discharge of the coke by means of a triplex chain-fall. The coke drops into a portable steel tank and is then dragged from under the retort and quenched with water drawn from an elevated reservoir.

Through the offices of the purchasing agent of the Ohio State University and the secretary of the Southern Ohio Coal Operators' Association carload lots of coal representing the important fields and seams of the



FIGS. 3 AND 4—TWO VIEWS OF THE BYPRODUCT RECOVERY SYSTEM

southwestern Ohio coal regions were shipped to the university siding. In nearly all cases the coal shipped was run of mine. Out of each carload there was taken a sample amounting to 5 tons for testing, for which the shipper received no pay, the university paying for the rest of it at the prevailing rates. The coals were tested as soon as possible to prevent the weathering changes that affect the quality of coke and gas from the coal.

The 5-ton sample of coal previously referred to is put through a set of Jeffrey rolls, which crush it to about $\frac{1}{2}$-in. size. One ton of this crushed coal is then carefully weighed and hoisted by means of a winch into the bin *O*. All the meters are then inspected to see that they are set at zero, the seals are inspected to see that they are closed, the circulating pump *J* is started and the recording pyrometer *P* is read to be sure that the temperature is satisfactory; the door *Q* at the top of the retort is then opened and the coal slides from bin *O* through shoot *R* into the retort. While the coal is running it is sampled several times, a sample weighing about 10 lb. being obtained. While the coal is running into the retort the water seal in the foul main *C* is drained into tank *S*, where it serves to dilute the ammonia liquors yielded by the coal. As soon as all the coal has run into the retort, doors *Q* and *B* are closed, valve *T* is opened, exhauster *H* is started and valve *U* regulated so that the manometer *V* indicates $\frac{1}{8}$ in. of water vacuum and manometer *W* on the foul main indicates $\frac{1}{10}$ to $\frac{1}{16}$ in. of water vacuum. Thereafter, during the entire run, valve *U* is regulated so as to maintain these vacuums, which are merely sufficient to withdraw the gas from the retort as fast as it is liberated. As soon as gas commences to burn in furnace *I* the motor of the gas calorimeter *M* is started and the calorimeter put into operation by igniting the gas in it by means of a spark plug. At the same time the aspirators of the sulphur train *A* (Fig. 6) and light oil train *E* (Fig. 7) are started and these two determinations proceed continuously during the entire run.

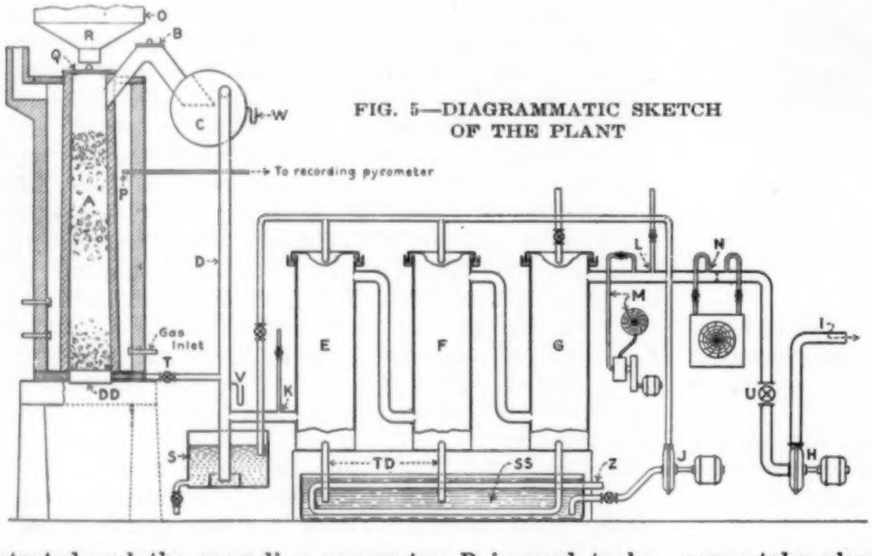


FIG. 5—DIAGRAMMATIC SKETCH OF THE PLANT

During the 10 to 18 hours which the carbonization of the coal requires, the operator's duties consist merely in seeing that the valve *U* is changed when necessary to maintain the proper vacuum on the retort, that the circulating pump is circulating the sulphuric acid liquor at the proper rate and that the proper excess of sulphuric acid is maintained in the circulating liquor, that the temperature of the retort is properly maintained, that the recording calorimeter, recording meter, sulphur train, light oil train, etc., are properly functioning.

The operator is instructed to regard the test ended when the rate of gas made per hour drops to 300 cu.ft. or when the B.t.u. value of the gas being made drops to 300 B.t.u. net per cu.ft., as it is not likely to be profitable to operate any retort plant beyond this point. It is interesting to note that usually the B.t.u. value drops to 300 at about the same time that the rate of gas making drops to 300 cu.ft. per hour.

When this point has arrived, the operator stops the sulphur and light oil determinations and records their meter readings, records the total volume of gas made and any other special records that are called for, shuts down the circulating pump, closes valve *U* and stops the exhauster, climbs quickly to the top of the retort and opens bridge-pipe door *B* to permit the remaining gas to escape into the atmosphere. It was very essential that valve *U* and all other openings in the by-product system be kept tightly closed until the bridge-pipe in foul main *C* is sealed off with water, as otherwise, owing to the chimney effect of the light coal gas in main *D*, air would be sucked into the system, resulting in an explosion in the foul main. This is quite disconcerting, as it generally blows the water-sealed top of tower *E* off—sometimes hitting the ceiling of the room. The towers *E*, *F* and *G* were designed with loose water-sealed tops to take care of this contingency. However, the explosions never take place if valve *U* is closed before opening door *B* and if thereafter no opening is made in the byproduct system (such, for instance, as might be made if the sulphuric acid solution sump *SS* were drained, exposing the bottom of the tower drains *TD*) until the bridge-pipe in the foul main *C* is sealed by water. (Since these tests the equipment has been changed and some of these operating details no longer apply.)

The tests were usually started about 8 a.m. so that they were finished before midnight. At this time the operator left for the night.

In the morning the discharge door *DD* at the bottom of the retort was opened and the coke dropped into the steel tank beneath the retort, the tank pulled under the quencher *WQ* and quickly quenched with the well-distributed spray. The tank *QT* when filled to 1 ft. from the top holds just enough water so that when it is all quickly sprayed upon the hot coke, the coke is quenched, but enough heat is retained to dry the coke partly.

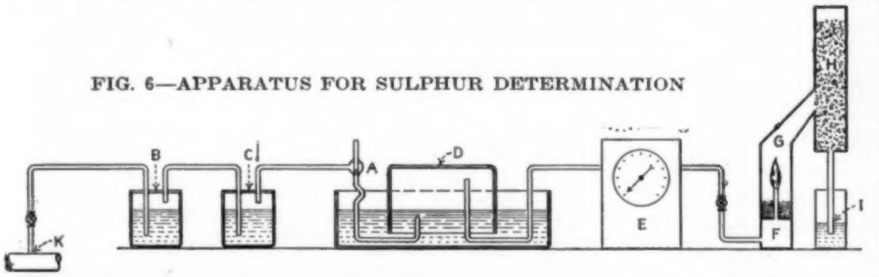
While the coke is drying, the tar and ammonia liquor is drained out of the foul main *C* into tank *S*. The main is filled with fresh water. The liquor in the sump *SS* is pumped into tank *S* and the bottom scraped to remove any tar clinging to it. After sufficient time has elapsed to allow the tar and water in tank *S* to separate by gravity, they are drawn off and weighed separately and samples of each set aside for analysis. The coke is then screened through a 1-in. screen, each size being weighed. About 50 lb. of the coke comprising oversize and undersize in proper proportions is weighed, dried and weighed again to obtain the moisture in the coke. The dried coke is then sampled for analysis.

After oiling the motors, renewing the solutions and putting fresh recording charts on the recording instruments, the equipment is then ready for the next run. Under this schedule it was not feasible to make more than one test in 2 days if the tar, ammonia, etc., were obtained from each run. With a larger force a complete run can be easily made each day, and with two shifts two runs could be made in 24 hours.

The methods of chemical analysis used for the coal, coke, tar, ammonia liquor, gas, etc., are the standard methods usually followed by fuel chemists. (See the Gas Engineers' Handbook, Second Edition.) These routine methods will not be described in this article, but it is advisable to indicate somewhat in detail the way in which the "organic sulphur," "light oils" and naphthalene are determined. These determinations are started in the beginning of the run and continue until the test is ended.

As soon as the test on a coal sample is started, the determinations here described are started. For the sulphur determination the aspirator *A* (Fig. 6) draws gas from the main at *K* through the wash bottles *B* and *C*, which remove the H_2S. The gas discharges from the aspirator with the water into the inverted glass tank *D*, thence through meter *E* and into the burner *F*, where it ignites. This burner *F* is inclosed under the chimney *G*, in which is a large supply of ammonium carbonate that slowly vaporizes and passes with the burned gases into the tower *H*. This is filled with broken quartz and down its sides slowly trickles a solution of ammonium carbonate, which accumulates in the vessel *I*, containing all the sulphur of the gas that passes the wash bottles *B* and *C*. Bottles *B* and *C* are filled usually with a NaOH solution, although occasionally a copper sulphate solution is used to remove the H_2S in the gas. Tests show that either solution is satisfactory for this purpose. Therefore, the sulphur in the gas which burns at *F* is only the sulphur which is in thegas combined as CS_2, CH_3S or other "organic compounds" which are difficult to remove in the purifying processes of commercial gas making. The liquor accumulating in *I* is diluted, an aliquot part taken, bromine added, heated, made acid with HCl, boiled and the sulphur precipitated as barium sulphate and weighed. The result is calculated to grains of sulphur per 100 cu.ft. of gas.

FIG. 6—APPARATUS FOR SULPHUR DETERMINATION



"Light oils" are determined in the gas taken from the main at *L* (see Fig. 7), drawn by aspirator *E* through the NaOH solution in *A*, solid calcium chloride in *B* and the bottles *C* filled with a heavy petroleum oil, and then through the meter *D*. The bottles *C* are weighed before and after the run and the increase in weight in the "light oils."

The naphthalene determination was made by the usual picric acid method on a half dozen samples, the gas being drawn from the main beyond tower *G* (Fig. 5). These determinations all gave practically identical results, showing that the naphthalene in the gases is practically a constant at the temperature of tower *G*, which is cooled by hydrant water. The results average 0.0035 gram per cu.ft., or 5.4 grams per 100 cu. ft.

These results for "organic sulphur" and "light oils" are incorrect in so far as the amount of sample withdrawn per minute was the same throughout the run while the amount of gas made varies from hour to hour. The sample taken should, for strict accuracy, be proportioned to the rate of gas making. The error made is not large, however, and the results are sufficiently accurate for comparative purposes. For the exact work to be published in a later contribution a proportioning meter will be used.

Many coals as they are mined contain so much ash and sulphur that the coke would be quite inferior and, of course, the quantity of gas would be correspondingly reduced. It was decided to wash as many of the coals as time and funds permitted, in order to determine any benefits obtained. A large proportion of the coals received, therefore, had at least three tests made on them —two tests on the coal as received and one test on the washed coal.

The washing was carried on under the direction of Prof. W. A. Mueller of the department of metallurgy and the equipment used was that belonging to the department. The coal was crushed and sized by screening, obtaining two products—through ¼-in. mesh and on ¼- but through ½-in. mesh. The coarse product was jigged in a full-sized Jeffrey jig and the small-sized product was tabled on a Wilfley table. The purified products from these two operations were dried, sampled and mixed. One ton of the mixed material was weighed and retorted exactly as the raw coal was treated.

Department of Metallurgy,
School of Mines,
Columbus, Ohio.

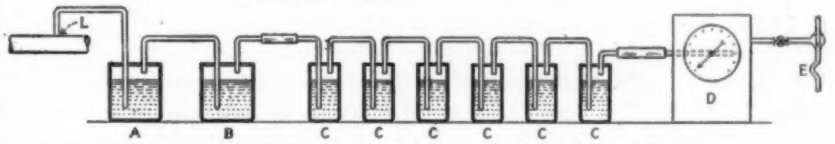


FIG. 7—SET-UP FOR LIGHT-OIL DETERMINATION

EDITOR'S NOTE: *The detailed results obtained in these researches and the author's comments thereon will appear in a subsequent issue of this magazine.*

Pulpwood Production in 1921

Preliminary statistics compiled by the Bureau of the Census show the following figures for 1921:

PULPWOOD CONSUMPTION AND WOOD-PULP PRODUCTION, BY STATES: 1919, 1920* and 1921

State	Pulpwood Consumption (Cords) 1921	1920	1919	Wood-Pulp Production (Tons, 2,000 Lb.) 1921	1920	1919
United States...	4,557,179	6,114,072	5,477,832	2,875,601	3,821,704	3,517,952
Maine...........	1,005,158	1,389,495	1,279,852	710,329	942,730	916,764
Michigan.........	186,532	243,632	207,234	103,532	132,776	106,194
Minnesota........	164,547	254,193	203,862	117,934	170,216	129,560
New Hampshire...	258,206	403,530	375,597	152,797	239,634	232,134
New York........	781,168	1,130,505	1,055,145	606,869	830,045	811,958
Oregon and California......	192,869	190,399	171,765	124,494	148,877	123,990
Pennsylvania.....	326,486	490,784	423,822	167,310	238,013	215,686
Wisconsin........	867,195	964,781	854,185	488,501	548,528	506,549
All other states....	775,018	1,046,753	906,370	403,835	570,885	475,117

* Compiled by the Forest Service.

The Measurement of Stirrer Performance*

A Method of Measuring Stirrer Performance Is Suggested and Experiments in Which It Has Been Applied to the Ordinary Paddle Stirrer Are Described—The Surprising Efficiency of a Paddle Stirrer Also Is Discussed

BY J. C. WOOD, E. R. WHITTEMORE AND W. L. BADGER

THE purposes for which stirrers are used may be analyzed as follows:

1. To mix two or more mutually soluble fluids.
2. To emulsify two or more mutually insoluble fluids.
3. To hold an insoluble solid in suspension in a fluid.
4. To dissolve a soluble solid.
5. To mix two or more viscous, pasty or solid materials.

Evidently the performance of any given device will be different when applied to the various uses above enumerated; and in many cases in practice a given device will be of appreciable value only in one of the cases. Case 4 is perhaps only a special case of case 1, since it consists mainly of removing a film of saturated solution from the surface of the crystals and mixing it with the bulk of the solvent. It is hoped to present a paper soon on this phase of stirring.

The theory of stirring has never been discussed to the writers' knowledge; nor is there in the literature any quantitative data on the performance of any type of stirrer, from either the standpoint of power consumption or time for complete mixing. The writers have no mathematical theory to offer. We believe, however, that the fact that our experimental data seem to be unique gives them importance in spite of the fact that they are purely empirical.

EXPERIMENTAL METHODS AND EQUIPMENT

The tank used in this work was a wood tank about 5 ft. in diameter by 5 ft. high, and held about 600 gal. It was provided with a paddle stirrer (shown in Fig. 1). It had a vertical wood post (3x3 in.) standing in a simple step bearing and rotated by bevel gears and a countershaft. To this vertical post was attached a blade formed of a 3x3-in. timber shaved off at an angle of 45 deg. as indicated. This type of stirrer is very common and is regularly furnished by practically all makers of tanks.

The principal problem was, obviously, to determine when the tank was stirred. Sampling tubes of seamless copper ¼ in. inside diameter were inserted at four levels (1, 2, 3 and 4 ft. from the bottom of the tank) and extended in for three different radial distances at each level.

Figure 1 is a view of the inside of the tank showing these tubes. These proved to be stiff enough to hold their position with the most violent stirring used. They were brought down the outside of the tank and all ended at a common level so that the hydrostatic head on the outlet was the same for all.

At first, methyl violet was used. It was added in the form of a paste in water. Samples were taken from all tubes every 30 seconds and measured in a colorimeter. This was very slow and very trying on the eyes, and the work was greatly delayed by cloudy days. Also occasional tarry lumps of the dye would lodge in

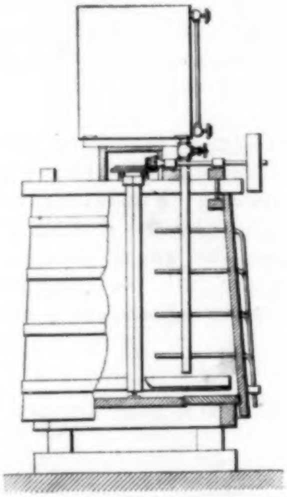


FIG. 1

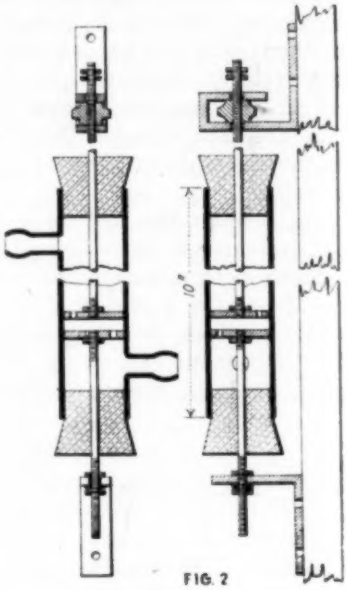


FIG. 2

Fig. 1—Arrangement of apparatus
Fig. 2—Details of conductivity cell

the end of one of the sampling tubes and spoil the whole run. This method was therefore abandoned.

Next was tried the addition of strong commercial hydrochloric acid, with titration of the samples. This was also very slow and tedious. It took 4 to 5 hours to make a test and analyze the samples. This preliminary work, however, showed that stirring was quite rapid. Most of the runs indicated a time of stirring of about 1 minute.

THE CONDUCTIVITY METHOD FINALLY ADOPTED

Finally the two junior authors developed a method based on electrical conductivity which promises to have a wide range of usefulness. A number of crude conductivity cells were made, and mounted so that liquid from the sampling tubes could be drawn through them. Several different types were used, but the form shown in Fig. 2 was found to be the most useful. The electrodes were of brass, but with alternating current no troubles were experienced from electrolysis. The position of the upper electrode could be accurately adjusted. In the tests here reported, four or five such cells were connected in series electrically, with a total drop of 220 volts across the set. Through each one was drawn a stream of liquid from one of the sampling tubes, and across each one was connected a voltmeter. The electrodes were adjusted before a test so that all the cells had the same electrical resistance at the start.

The tank was first filled with city water and then a small amount of saturated sodium chloride solution was run in from a storage tank. The amount used corresponded to 4 lb. solid salt per foot of water in the tank. The arrangement (shown in Fig. 1) permitted this solution to be added at the bottom of the tank. The

*Paper presented at the Richmond meeting of the American Institute of Chemical Engineers, Dec. 6 to 9, 1922.

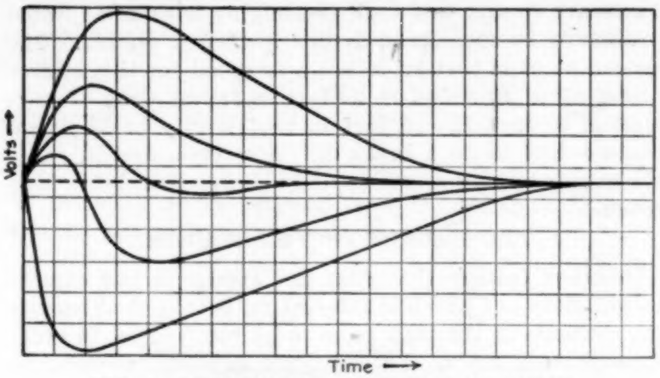


FIG. 3—THEORETICAL VOLTAGE CHANGES

stirrer was then started and readings taken of voltage changes, current, speed and power consumed. The routine was developed to the point where a run with all its data could be made, the tank dumped and made ready for the next run in 10 minutes. A preliminary study showed that the points nearest the center at each level were the last to come to equilibrium with the rest of the tank. Through a large part of this work only four voltmeters were available, and hence the sampling tube at the inner point at each level was used.

Adding strong salt solution to the bottom of the tank should decrease the resistance of the bottom cell and hence decrease the voltage drop across it while increasing the voltage drop across the other cells. As the salt is mixed with the tank contents this resistance should gradually rise to its final value at equilibrium. In the same way, the voltage across the second cell from the bottom should first rise, because, though its resistance had not changed, the decreased voltage drop across the bottom cell should increase the drop across all the others. But when the level of the salt solution rises to the second sampling tube, the resistance of the second cell (and its voltage also) should suddenly drop, with a corresponding increase in the voltage of the cells above it.

Discussion of Results

Theoretical Value of Conductivity

Based on such a line of reasoning, the change in voltage drop across the cells should be as shown in Fig. 3. Actual data from a typical run are shown in Figs. 4 and 5, exactly confirming the theory. Fig. 4 represents a run with water 4 ft. deep, and Fig. 5 one with water 3 ft. deep. In Fig. 4 cell 1 was connected to the center sampling tube 1 ft. from the bottom, cells Nos. 2, 3 and 4 being the corresponding points at the

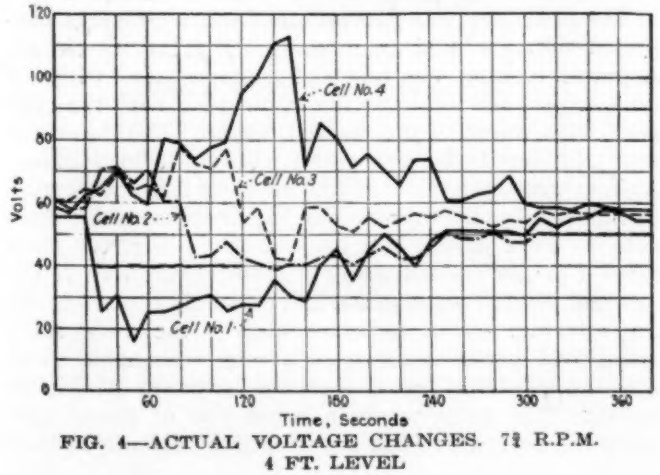


FIG. 4—ACTUAL VOLTAGE CHANGES. 7½ R.P.M. 4 FT. LEVEL

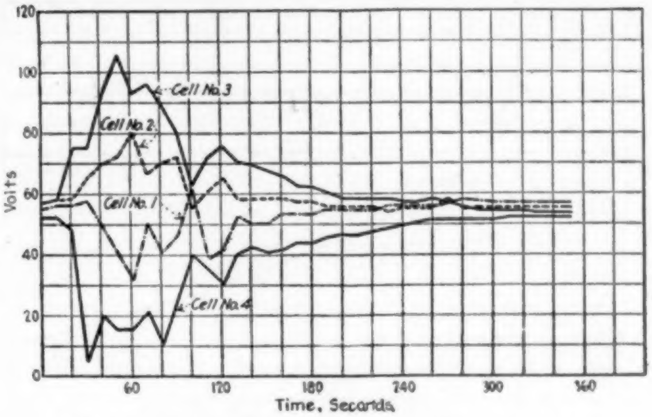


FIG. 5—ACTUAL VOLTAGE CHANGES. 7½ R.P.M., 3 FT. LEVEL

2, 3 and 4-ft. levels. In Fig. 5 cells 1, 2 and 3 connect to the same tubes as before, but cell 4 was connected to the outer tube at the 3-ft. level. These runs were made with a cruder type of cell than the one shown in Fig. 2 and they could not be accurately adjusted for equal resistance (and hence equal voltage drop).

The way in which the curves of Fig. 4 correspond to our theory is most satisfactory. As strong salt solution is stirred and passes upward, the resistance of the cell suddenly decreases in regular order and the voltage across the rest rises. A most interesting point in Fig. 5 is that the outer *top* cell shows salt before the inner *bottom* cell. This is the result of a centrifugal component of the action of the stirrer, transformed into a vertical current of strong solution by the tank wall.

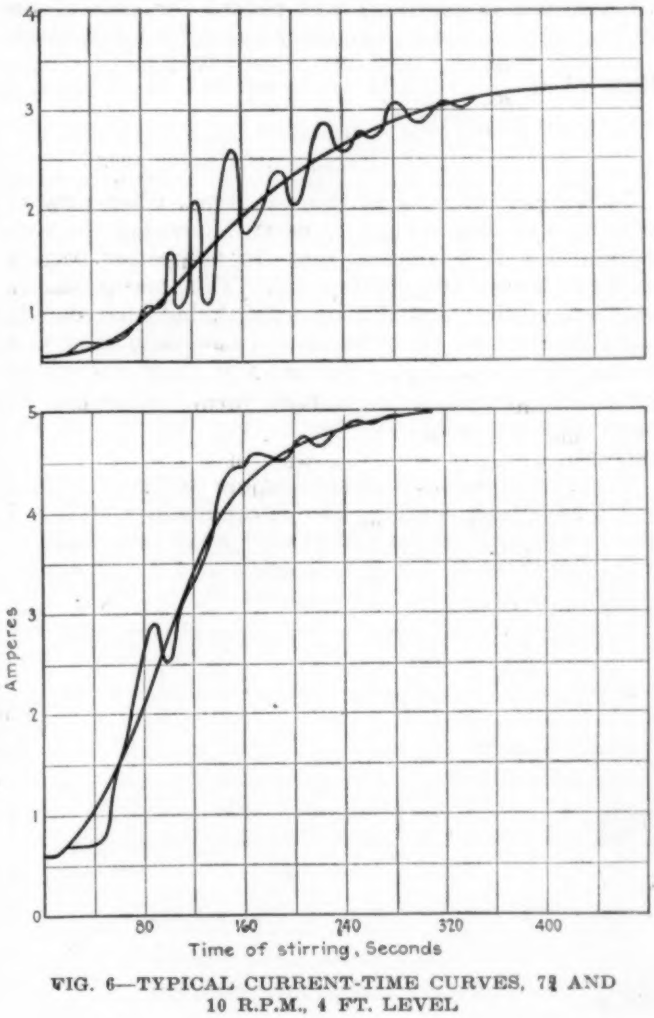


FIG. 6—TYPICAL CURRENT-TIME CURVES, 7½ AND 10 R.P.M., 4 FT. LEVEL

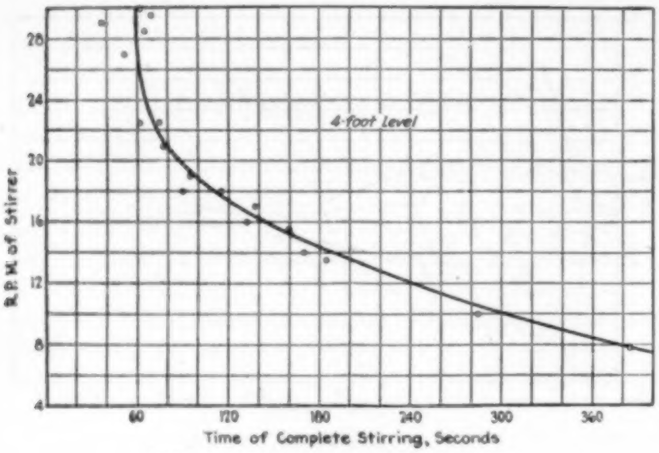


FIG. 7—STIRRER PERFORMANCE

Through most of the work the stirring was so rapid that changes in the voltmeter readings could not be followed. It was observed that the current in the circuit rose and became constant at about the time the voltmeters became uniform. By reading the ammeter every 10 seconds a current-time curve could be plotted, which approached an asymptote parallel to the time axis as stirring became complete. Most of the work was based on this curve. Samples of such curves are shown in Fig. 6. The pulsations in the observed curve represent slugs of strong solution swept past the ends of the sampling tubes by the rotation of the stirrer. A smooth mean curve was put in for purposes of computation. A curve which approaches an asymptote does not give a satisfactory end-point. The first derivative (determined graphically) was plotted for each of the current curves, and an arbitrary end-point taken as the time when $\frac{dc}{dt} = 0.04$ (c = current in amperes, t = time in seconds).

Vertical and Horizontal Uniformity

In the case of runs at the 4-ft. level, when time of stirring was long enough to permit following the voltmeters also, it was found that the voltmeters became constant before the current did. This means that a uniform vertical distribution existed, but that due to centrifugal action there was still a non-uniformity in a horizontal plane. The difference was great enough at very slow speeds to be unmistakable. Hence in all cases the end-point was taken from the curves for current.

From these methods of reading the curves of Figs. 7 and 8 have been plotted. The determinations of Fig. 7 were made with the tank filled with water to a depth of 4 ft., and those of Fig. 8 to a depth of 3 ft. The most striking thing about these curves is the short time

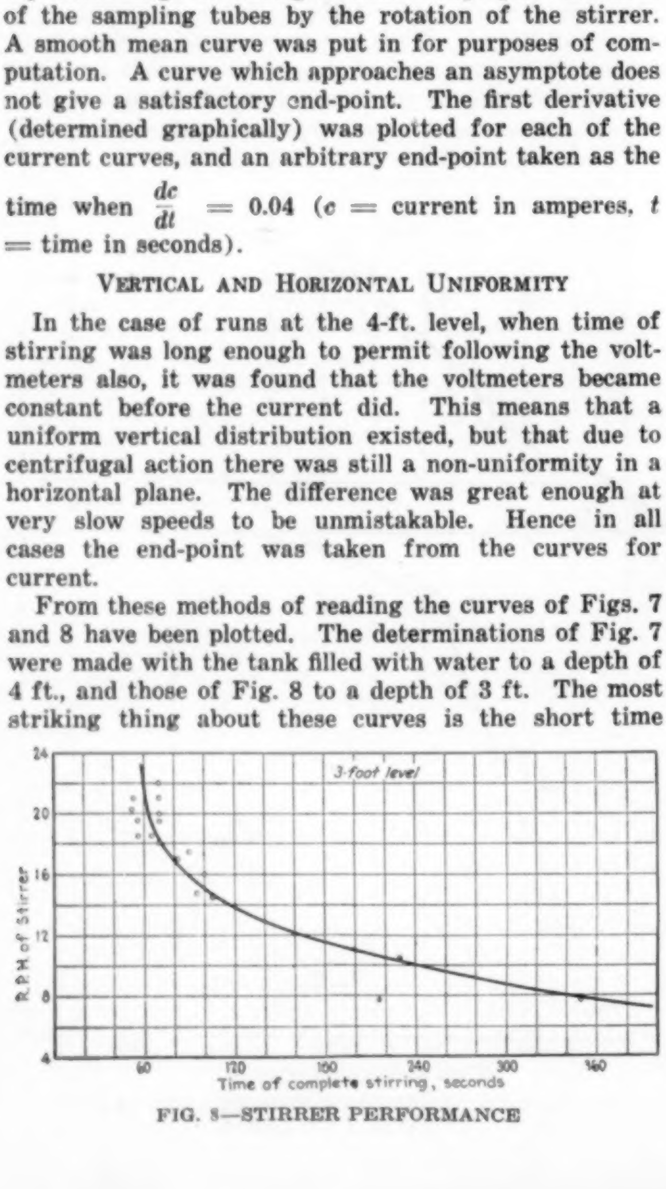


FIG. 8—STIRRER PERFORMANCE

necessary to mix this tank thoroughly with what would ordinarily be considered a very inefficient stirrer. The second point is that an increase in speed for this stirrer above 18 to 20 r.p.m. is useless so far as time of stirring is concerned. In fact in the vicinity of 30 r.p.m. there seems to be a break in the curves, and at rates above this mixing seems actually slower than below this speed.

The Illusion of Visible Swirl

Another feature that does not appear in the experimental data but which is interesting is that at all speeds the contents of the tank seem to be rotating as an even, homogeneous mass. The advocate of some special type of stirrer would insist that the contents of the tank were not being stirred at all. There was no visible swirling, eddying, churning or other indications of crossing of lines of flow. That this type of motion may produce very rapid and efficient mixing is a new thought in stirrer design. One needs but to consider the *apparent* motion of a fluid in a transparent tube at velocities above the critical. Small visible suspended particles move, apparently, in straight lines; yet the flow may be fully turbulent. Visible motion is due to particles of suspended solids which may very well have inertia

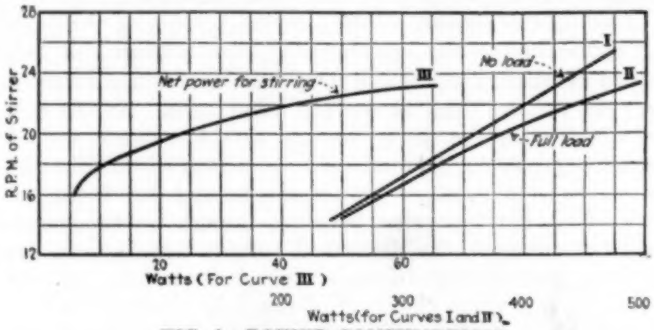


FIG. 9—POWER CONSUMPTION

Curve I, no load. Curve II, full load. Curve III, net power for stirring.

enough to flow in fairly straight lines in spite of the fluid turbulence around them. So in mixing two mutually soluble liquids (as salt solution and water) the visible motion of the mass is not an index of the true degree of turbulence.

Measurements of power consumed were not satisfactory. So much power was consumed in shafting, belting, gears, etc., that the power actually used for stirring was too low to measure for the slower speeds. Power measurements were simplified by the fact that a d.c. motor was used. Shunt field power was determined once and considered constant (as the control rheostat did not affect the voltage across the shunt coils). Power in the armature was determined from a properly connected voltmeter and ammeter in the armature circuit. A power reading was taken at a given speed with the tank empty, and again at the same speed with the tank filled with water to the desired height. The difference was considered the net power consumed in stirring. At slow speeds it was so small as to be less than errors introduced by fluctuations in the instruments. Such data as were determined are shown in Fig. 9. Here curve I is the no-load power consumption, curve II the full-load power consumption, and curve III the net power for stirring. This indicates clearly the very small amount of power really used at any reasonable speed and the relatively rapid increase in power at higher speeds. The point where a rapid rise of power consumption occurs without a perceptible increase in time

of stirring is one of the useful results to be obtained by applying this method of analysis to the stirring device.

Studies are now under way on rate of dissolving crystals and on the characteristics of propeller stirrers.

Conclusions

1. A plain paddle stirrer is a much more efficient mixer for miscible liquids than is usually supposed.
2. For the conditions of this set of experiments, a 600-gal. tank was thoroughly stirred in less than 1 minute at any speed above 22 r.p.m., though above 30 r.p.m. there seemed to be an increase of stirring time.
3. The visual appearance of a tank of liquid being stirred is not a measure of the efficiency of the stirring apparatus.
4. At the speed above which there is no gain in time of stirring, there is a rapid rise in net power consumption.

Chemical Engineering Department,
University of Michigan,
Ann Arbor, Mich.

Gas in Steel for Welding

About two years ago, according to the August, 1922, number of *Oxy-Acetylene Tips*, a trade publication of the Linde Air Products Co., a certain tube manufacturer reported welding troubles, which upon investigation seemed to be confined to a certain shipment of steel. Welds made on these strips in regular production were very brittle and had a rough outer surface. It appeared impossible to get a good weld with this material, and samples of it, together with some of satisfactory material, were critically examined at the company's research laboratory in Long Island City. Strips of the steels were connected up like blowout fuses in a vertical line, and a 12-volt current of high amperage was passed through the series until the strips began to melt at their centers. The current was then switched off, and the strips were closely observed in the process of cooling.

The good steel cooled off without any decided change in appearance, excepting a rounding off at the edges. The bad steel puffed and sparks were thrown off, an action that had been observed and reported in connection with the unsatisfactory welding of the metal at the tube company's plant. After the cooling had proceeded for some time the sample was found to be pitted with little holes and craters of larger dimension.

These results have been reported to the American Welding Society, and that organization is using the studies in a campaign designed to educate its members on the desirability of using only sound, gas-free metal for their welding operations.

Chinese Market for Chemicals

China is becoming an increasingly important market for chemicals, says Commercial Attaché Julean Arnold. Local manufacturing plants are springing up in connection with the production of certain commercial chemicals, which compete with the foreign products in some lines to such an extent as to reduce the trade materially. This is especially true of sulphuric, hydrochloric and nitric acids.

Details of the quantities of these various chemicals imported are lacking, official Chinese returns combining most of them under the head, "chemical products (not including match-making materials, medicines and soda)." Net imports of this group in 1921 were valued at 2,817,964 haikwan taels, against 2,291,203 taels in 1920. Match-making materials (except paraffine wax) were imported in 1921 to the value of 2,281,181 taels, compared with 1,893,670 taels in 1920; medicines (including cocaine and morphia), 7,056,080 taels, against 6,790,230 taels. In addition, were imports of glycerine valued at 93,280 taels, against 106,213 taels; soda, 1,775,509 taels, against 2,308,669 taels; and explosives for industrial purposes, 174,619 taels, against 237,723 taels.

Legal Notes

By Wellington Gustin

Similarity of Results in Patent and Secret Process May Justify Conclusion of Infringement

A patent and a secret process conflict in the case of A. B. Dick Co. versus Barnett is decided in the United States Court of Appeals, 277 Federal, 423. The federal District Court granted a preliminary injunction against the defendant preventing his sale of "Hesco" stencil paper, which is alleged to be an infringement upon the plaintiff's Fuller patent, No. 1,101,268.

Plaintiff owns patents covering the process and the product of plaintiff's so-called indestructible mimeograph stencil paper "Dermatype." These patents have been sustained in prior suits, therefore it was quite proper to assume their validity in the present suit on motion for a preliminary injunction, says the court. The contest then was as to infringement of them by defendant's acts.

This controversy turns on the construction to be given the claims in suit. Defendant contended that they were limited to a fully and permanently coagulated (insoluble) gelatin, and that the defendant's coating was almost entirely soluble. The experts were in conflict as to the true scope of the claims, as well as the nature of the plaintiff's process and its resultant product. The trial court recognized that whether the defendant used "a fully coagulated substance" or "a coagulated collodial substance" or their equivalents, within the meaning of the claims in suit, was a debatable question.

In reversing the order granting a preliminary injunction against the defendant by the District Court the Court of Appeals says that while plaintiff must demonstrate infringement, similarity of result may justify a conclusion of infringement, in the absence of proof that in some respects the secret process (which need not, however, be disclosed) or the resulting product differs from the patented process or product. Here, however, the affidavits of the expert and of the "Hesco" manufacturer, while guarding the secret process, purport to show important differences. Without passing upon their sufficiency, they raise at least a reasonable doubt as to infringement. The rule of law laid down and applicable here is that to justify a preliminary injunction in a patent case plaintiff has not merely the burden of proof but must "establish a *prima facie* case free from reasonable doubt."

For while ordinarily a preliminary injunction aims to preserve the *status quo* pending suit, in a patent case like this it may destroy it, says the court.

Equilibrium Diagram Of the Iron-Carbon System*

By Kôtarô Honda
Bessemer Medalist

Metastable or Graphite Lines Are Rejected, the Solidus Redrawn, A_4 or Delta Iron Fields Are Introduced—A_2 and A_0 Represent No Changes in Phase, but Are Traced Across the Diagram

MANY important investigations of the properties of the alloys of iron with carbon have recently been made, and the constitutional diagram of iron and carbon must be modified in some important points.

Some metallurgists believe that graphite always results from the breaking up of cementite soon after its solidification owing to its instability at very high temperatures. From the mode of occurrence, other metallurgists contend that it is a product directly separated from the melt, the graphitization taking place more easily in proportion as the rate of cooling through the solidifying range is smaller, and they propose the so-called double diagram representing the stable and unstable equilibriums.

Graphitization

According to the result of recent investigations by Dr. T. Murakami and the present writer,[1] graphite in cast iron is not a product directly separated from the melt, but is produced in the range from 1,130 to 1,050 deg.—that is, the graphitization always takes place after the solidification of the melt. This result was obtained from quenching experiments at very high temperatures. Thus the double diagram as given in many text-books of metallurgy is not correct, in agreement with Sauveur's view.

The question whether the liquid iron-carbon alloys contain carbon as graphite or as cementite has an intimate connection with the two theories of graphitization above referred to. Dr. Murakami and the present writer cooled the liquid alloys at different rates, or quenched them in a thick iron mold having a narrow hole, 2 mm. thick, 3 cm. wide and 6 cm. deep. This mode of quenching the melt was more effective than quenching in water. The quicker the rate of cooling the less the degree of graphitization. By quenching in the iron mold, even hypereutectic alloys approaching to the concentration of pure cementite do not graphitize at all.

These results show that in a liquid state carbon exists in the combined state, otherwise quick cooling will cause a greater degree of graphitization. If this conclusion be correct, it is very natural to conceive that the first product of solidification is cementite.

The formation of graphite is not a direct decomposition of cementite by equation

$$Fe_3C = 3Fe + C$$

but it is due to a catalytic action of gases, such as carbon monoxide or dioxide. The mechanism of this catalytic action is not yet certain, but the following assumption will not be far from the fact: As the temperature of the specimen falls from the melting point, a minute quantity of free carbon dioxide coexisting with carbon monoxide soon reacts on cementite and produces carbon monoxide by equation

$$Fe_3C + CO_2 = 2CO + 3Fe$$

This diminution or disappearance of free carbon dioxide causes a further dissociation of carbon monoxide

$$2CO = CO_2 + C$$

reproducing the dioxide, which again reacts with cementite. Thus, if there is in the metal a small quantity of free carbon monoxide, these two reactions are continuously repeated, and graphite is gradually produced with the consumption of cementite. The most favorable temperature for the graphitization is just below the eutectic point, 1,130 to 1,100 deg., but as the temperature falls, graphitization becomes less.

Thus, since graphitization always takes place after the solidification of the melt, the graphite lines in the double diagram must be omitted.

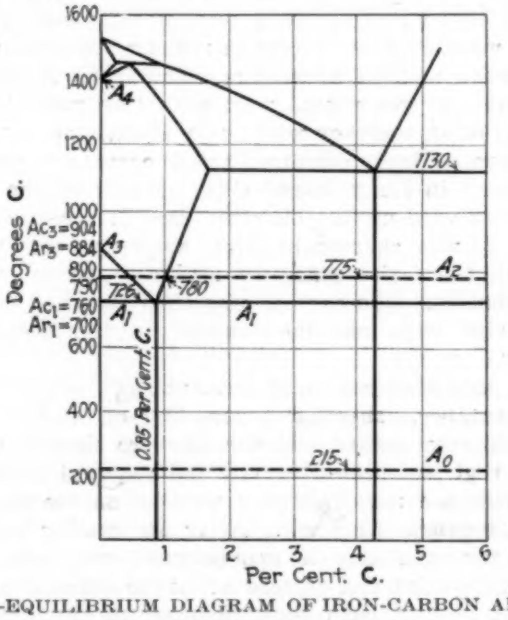


FIG. 1—EQUILIBRIUM DIAGRAM OF IRON-CARBON ALLOYS

In the recent diagram of the iron-carbon system, the solidus is usually shown as a curve bending considerably downward. But it can be shown by thermodynamics that if the liquidus is straight or slightly curved, the same must also be true for the solidus. Hence in my constitutional diagram (Fig. 1), the lower portion of the solidus is slightly bent upward.

A_4 or γ-δ Transformation

This is an allotropic transformation characteristic of pure iron; it was first observed by Osmond[2] thermally, then by Curie[3] magnetically, and afterward by others. The mean values of the recent measurement for Ar_4 and Ac_4 points are 1,400 and 1,410 deg. C. respectively. Ruer and Klesper[4] found that A_4 rapidly rises with the increase of carbon, and that at 1,486 deg. C. the melt

*The sixtieth report (slightly abstracted) from the Iron and Steel Research Institute, Sendai, Japan. This paper was communicated to the May meeting of the Iron and Steel Institute, 1922.

[1] Iron and Steel Inst. No. 2 (1920). *Science Reports*, Imperial Tohoku University, vol. 10 (1921), p. 273.

[2] *Iron and Steel Inst.* No. 1 (1890), p. 102.

[3] *Oeuvres*, p. 289.

[4] *Ferrum*, vol. 12 (1914), p. 257; (1916-17), p. 161.

with 0.38 per cent carbon is in equilibrium with γ- and δ-irons of the concentrations 0.18 and 0.07 per cent carbon respectively.

The recent progress of X-ray analysis has revealed the actual configuration of atoms in α- and γ-irons; but owing to the difficulty of experimenting at the high temperature, the determination of the atomic configuration in δ-iron has not yet been made. Judging from its physical properties, however, it seems to me very probable that the space-lattice in δ-iron is a body-centered cube as in α-iron.

A_3 OR α-γ TRANSFORMATION

This is a well-known allotropic transformation characteristic of pure iron; the transformation point during heating (Ac_3 point) is 904 deg. C., and that during cooling (Ar_3 point) 884 deg. C. With the addition of carbon in iron, this point falls quite continuously, till it reaches the eutectoid horizontal or A_1 line at a concentration of 0.85 per cent C.

By X-ray analysis, it is found that γ-iron possesses a space lattice of a face-centered cube.

A_2 OR MAGNETIC TRANSFORMATION

This transformation is sometimes called the α-β transformation. On several occasions[5] I have shown that the A_2 transformation in pure iron is a progressive change beginning from the lowest temperature and ending at about 790 deg. C., its rate of change increasing with the rise of temperature. This progressive change, as revealed by its magnetic property, is clearly seen from the magnetization - temperature curve in a strong field (Fig. 2). Though the temperature is kept constant in the transforming range for a sufficiently long period of time, the magnetization—that is, the transformation—does not progress with time.[6] In other words, the internal change corresponding to the A_2 transformation is a definite function of temperature, unlike allotropic transformations, such as A_3 and A_4, in which the change takes place at a definite temperature, provided a sufficient time is allowed. Hence it is not appropriate to consider the A_2 transformation as an allotropic change of phase.

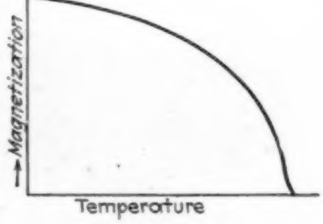


FIG. 2—MAGNETIZATION-TEMPERATURE CURVE OF PURE IRON IN A STRONG FIELD

The A_2 point as determined thermally is usually taken as 768 deg. C.; this is the temperature at which the rate of heat evolution or absorption is a maximum by cooling or heating respectively, and somewhat lower than 79C deg. proposed by the present writer. This latter is t. at at which the transformation begins on cooling or terminates on heating; it is the temperature at which iron changes from the ferromagnetic to the paramagnetic state. Since the change gradually takes place in the whole range of temperature below the A_2 point and every temperature in this range has the same quality with respect to the transformation, it is obviously not correct to call a temperature, 768 deg. C., at which the rate of change is a maximum, the A_2 or critical point or range.

According to the result of X-ray analysis,[7] below the A_3 point, iron has always the space lattice of a body-centered cube, which is in complete agreement with the view above given. There is thus no β-iron as an independent phase. The A_3 transformation during heating is then atomistically the change of the atomic configuration in iron crystals from a body-centered to a face-centered cube.

It remains to explain what is the nature of the progressive change in the A_2 transformation. According to the theory of Dr. J. Okubo and the present writer,[8] the gradual diminution of magnetization with the rise of temperature is due to the increasing velocity of rotation of the atoms about their magnetic axes. The angular velocity of this rotation is assumed to be comparatively small at room temperature, and the gyrostatic resistance to the turning of the magnetic axes of the atoms in the direction of the field is very small. But as the temperature is continuously increased to a very high degree, the angular velocity, by virtue of thermal impact among atoms, always becomes greater, and hence the gyrostatic action of the atoms rapidly increases, the substance becoming thereby less and less magnetizable, till magnetization vanishes. When the field ceases to act, the magnetic axes of atoms take random directions by virtue of thermal impacts. Thus in this theory, the A_2 transformation is of the progressive nature and the change will obviously be a definite function of temperature, as actually observed. The heat absorbed during Ac_2 transformation is the energy required to increase the angular velocity of the atoms, while the heat evolved during Ar_2 transformation is the energy of rotation liberated.

The A_2 points in pure iron during heating and cooling exactly coincide with each other, their value being 790 deg. C. According to the accurate magnetic determination of Ishiwara,[9] with the addition of carbon to iron, the Ac_2 point continuously falls to 780 deg. C. at about 1 per cent carbon and afterward remains nearly constant. Up to 0.5 per cent carbon, the Ar_2 point nearly coincides with the Ac_2 point, but afterward the former falls gradually below the latter, and at 4 per cent carbon, the difference amounts to 25 deg. C. Thus above the eutectoid points, the iron-carbon alloys are still ferromagnetic, though weakly so. Taking the mean of these two sets of values, the A_2 line beginning at 790 deg. continuously falls to 780 deg. at 1 per cent carbon and to 775 deg. at 4 per cent. Since the A_2 transformation is not the change of phase, the A_2 line is dotted.

From the above result, we conclude that above the eutectoid concentration the A_3 and A_1 points merge into a single point, but the A_2 point does not do so, as is usually believed to be the case.

Recently Ruer[10] observed in the heating curve of a cast iron (3.85 per cent C), a break at a point higher by 10 deg. than the cementite eutectoid point and took it for the graphite eutectoid; but according to the w.iter's view, it is attributed to the last part of the A_2 transformation, ending at the Ac_2 line.

A_1 OR EUTECTOID TRANSFORMATION

This is the transformation characteristic of steel or cast iron. During heating the transformation takes place at 760 deg. C., but during cooling at 700; this is the

[5]*Sci. Rep.*, vol. 4 (1915), p. 169; *Iron and Steel Inst.* No. 1 (1915); *Sci. Rep.*, vol. 6 (1917), p. 213.

[6]K. Honda, *Sci. Rep.*, vol. 5 (1916), p. 285.

[7]Westgren, *Iron and Steel Inst.* No. 1 (1921); Jeffries and Archer, *Chem. & Met.*, vol. 24 (1921), p. 1057.

[8]*Sci. Rep.*, vol. 7 (1918), p. 141.

[9]*Sci. Rep.*, vol. 9 (1920), p. 401.

[10]*Z. anorg. allgem. Chem.*, vol. 117 (1921), p. 249.

temperature at which cementite dissolves in iron or separates from it. Theoretically the A_1 line must be horizontal, extending to the concentration of cementite; but it actually rises slightly at higher concentrations of carbon, the maximum increase being 20 deg. This increase is very probably due to the presence of silicon in these alloys as impurities. For it is well known that silicon raises the A_1 point of steel, and though in these alloys the quantity of silicon present does not differ much, yet the ferrite in which it dissolves continuously diminishes as the carbon increases, being zero at the concentration of cementite. Hence the concentration of silicon in ferrite steadily increases as carbon increases, and hence the A_1 point is raised. On the other hand, manganese is known to depress the A_1 point. Hence as the quantity of silicon present as impurities is greater and that of manganese smaller, the rise of the A_1 point is greater. In my ideal diagram of the iron-carbon system, the A_1 line is drawn horizontally.

Considered from the point of view of the microstructure, the A_1 transformation consists in

$$\text{Austenite} \rightleftarrows \text{pearlite}$$

but as I have reported in other papers,[11] the above equation represents only the result—not the process itself. According to the writer's view, the process takes place in the order of

$$\text{Austenite} \leftrightarrows \text{martensite} \leftrightarrows \text{pearlite}$$

that is, during cooling, at the A_1 point the austenite changes to pearlite through martensite, and during heating the reverse change takes place. It should be here remarked that at the ordinary A_1 point, as soon as martensite is formed, it is immediately changed into pearlite or austenite, and hence in the case of equilibrium the martensite does not actually come into existence. Hence in the equilibrium diagram the martensite line ought to be absent It is only in the case of quenching or non-equilibrating transformation that the martensite is formed and, being formed, remains undecomposed.

Some metallurgists[12] object to the double reaction above mentioned, as contradictory to the phase rule, but they have misunderstood the meaning of the above reaction.

A_0 or Cementite Transformation

This is the transformation characteristic of cementite; it is in its nature the same transformation as the A_2 transformation in iron. The transformation is progressive and extends from the lowest temperature to 215 deg. C., the change being a definite function of temperature. During heating or cooling the transformation terminates or commences at the same temperature (215 deg. C.), the A_0 point. This point is observable for all alloys containing free cementite, and has always the same value. Since the transformation is not a true change of phase, in the constitutional diagram the A_0 line is drawn as a dotted horizontal line like the A_2 line.

Conclusion

To sum up, the constitutional diagram is greatly simplified on the one hand by the omission of the graphite line, and on the other by that of the β-iron line, that is, by introducing the dotted A_2 line. The A_0 line is newly added.

[11] *Iron and Steel Inst.* No. 1 (1919); *Sci. Rep.*, vol. 8 (1919), p. 181.

[12] Revue de Métallurgie, vol. 18, p. 433 (1921).

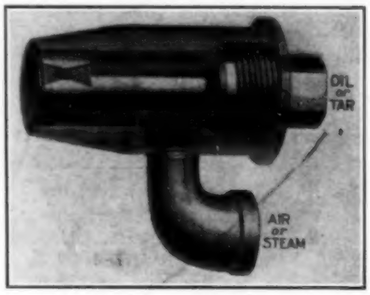
The Hauck Oil Burner

A New Appliance for Chemical and Metallurgical Heating Furnaces

THE Hauck Manufacturing Co., of Brooklyn, N. Y., has recently placed on the market a new and improved type of atomizer for burning fuel oil and distillate. This burner consists essentially of a cylindrical casing with slots parallel to the axis of the bore. These slots form with the inner wall of the casing longitudinal ports through which the atomized oil is impelled into the furnace. The ports are constructed in the form of a small Venturi tube, being constricted at the center portion and flared at both ends. At the throat or constricted portions of the orifice are radial openings which connect to the bore of the burner.

The material which is to be used for fuel is delivered to the burner through this central bore at a pressure of from 40 to 60 lb. per sq.in. It flows from the central bore through the radial openings into the restricted portions of the orifices.

The compressed air or steam which is used for atomizing is delivered to the burner at a pressure of about 80 to 100 lb. per sq.in. It flows longitudinally through the Venturi port opening, so that as it passes the constricted part of the opening its velocity is at the highest point. At this point it picks up the oil or other fuel which is delivered under pressure through the radial openings to the tube. It may be said to blast the oil and thus deliver it in the atomized or foglike form, which best promotes combustion.



It is claimed for this burner that it secures a thorough mixture of the air and fuel at the mouth of the burner. It is claimed also that it correctly proportions the air or steam to the oil, that it is accessible for purposes of inspection and that it can be conveniently removed from the furnace without affecting the operation of any other burner served by the same system.

Further advantages claimed for it are that reducing, neutral and oxidizing flames are readily obtained by the mere manipulation of the oil and air valves. This enables the operator to control closely the furnace atmosphere at the least expenditure of attention and labor. Another advantage claimed is embodied in the fact that combustion can be made to take place close to the burner nozzle, thus preventing oxygen from coming into contact with other portions of the furnace and reducing the amount of scaling. Another result of this lack of oxygen in the furnace atmosphere may be found in the reduction of spoilage and greater uniformity of the product obtained.

Instantaneous Measurement of High Pressures

Plates properly cut from quartz crystal liberate an electric charge when subjected to pressure. A stack of these plates in a small steel container is subjected to the pressure to be measured and the charge which is liberated passes through a special type of galvanometer. The galvanometer movements are photographed on a rapidly moving film.

Book Reviews

LABORATORY MANUAL OF COLLOID CHEMISTRY. By *Harry N. Holmes*, Professor of Chemistry in Oberlin College. John Wiley and Sons, Inc., New York; Chapman & Hall, Ltd., London, 1922. xii + 127 pp. 32 figs. 23.5x15 cm.

A "brief bibliography" of thirty-four titles of books dealing with the manifold theoretical and practical aspects of colloid chemistry, tabulated in pages 119 to 121 of this volume, indicates the considerable attention now paid to this important topic. In a field to which so many new workers are being continually attracted, it is obviously desirable to have an authoritative guide on experimental technique and methods. Previous manuals, such as Svedberg's "Herstellung Kolloider Lösungen," have covered only portions of the ground, usually for the benefit of more advanced workers. The need for a general laboratory outline of the subject, suitable for student use, has long been seriously felt, and the present volume has been prepared by Professor Holmes, at the request of the colloid committee of the National Research Council, to fill the gap.

In successive chapters the following subjects are developed: I, Suspensions—Coarse and Fine; II, Dialysis and Diffusion; III, Condensation Methods of Preparation; IV, Dispersion Methods of Preparation—Peptization; V, Coagulation; VI, Protective Colloids; VII, Solvated Colloids; VIII, Surface Tension; IX, Emulsions; X, Viscosity; XI, Adsorption From Solution; XII, Adsorption of Gases; XIII, Reactions in Gels; XIV, Experiments With the Ultramicroscope; XV, Soils and Clays; XVI, Special Topics. Altogether, no fewer than 186 experiments are outlined. No one student, of course, can be expected to perform all of these, and representative selections fitted for special courses are suggested in the introduction.

The book as a whole must be very highly commended. The directions, in general, are given in sufficient detail to enable the beginner to understand the purpose of each experiment and to take all precautions necessary to obtain the desired result, without being so full as to destroy his initiative. Much of the subject matter, of course, is intimately related with Professor Holmes' own research topics. A number of experiments have also been contributed by investigators well known in their particular fields, including W. D. Bancroft (on dyeing), S. E. Sheppard (on gelatin) and J. A. Wilson (on tanning). The greater part of the chapter on Adsorption of Gases is taken up with the work of Patrick on silica gels. With such a galaxy of experts, few errors of commission (and certainly none of omission) are to be expected. The relative space devoted to the work of Fischer and of McBain on soaps (pp. 35-39) might be reversed with considerable profit to the reader, and the purely empirical nature of the Freundlich adsorption equation (pp. 72-73) should certainly be emphasized, but these are minor points.

A more serious criticism that can be offered is that the author tends, in common with many of his colloidal colleagues, to exaggerate the scope of his special subject, and to inflate it unduly by including topics which properly belong elsewhere. It is a moot question whether adsorption ought to be included in colloid rather than in general physical chemistry, even though long-established custom in this case argues for its retention. To regard an experiment such as the catalysis of the reaction between carbon monoxide and oxygen by means of "hopcalite" (p. 110) as an application of colloid chemistry, however, is almost Ostwaldian.

Teachers of colloid chemistry will undoubtedly find this volume of the greatest assistance to them in the development of their laboratory courses. The frequent references to the original literature should prove a source of inspiration to the research worker, as well as to the student entering the subject for the first time.

JAMES KENDALL.

THE STEEL FOUNDRY. By *John Howe Hall*. Cloth 6x9 in. 334 pp. McGraw-Hill Book Co., Inc., New York, 1922. Price, $4.

Mr. Hall tell us that he has aimed at setting forth the metallurgy of the steel foundry from the point of view of the steel foundry engineer who is interested in securing a product of high quality at the lowest cost commensurate with this quality. The result is a readable and valuable book with a range extending considerably beyond the steel foundry proper.

The various processes of steel making are dealt with: crucible; acid and basic electric; acid and basic open-hearth, and bessemer, side-blow and bottom-blow. These are considered first in the light of their availability for the manufacture of steel castings, judgment being passed on the following points: Market, including quality, style of casting to be made, cost of production, tonnage in sight; raw material and fuel available; capital available; competition; labor available, and uniformity of operation. Mr. Hall states fairly the advantages and disadvantages of each process and gives estimates of cost for installation and operation. If there is such a person as a foundry engineer undecided as to the process to be chosen for a proposed foundry, he will find indicated here his proper course of reasoning.

This preliminary survey of methods of steel making is followed by a detailed account of the methods of operation for each process. To the foundry engineer who wishes to extend and consolidate his knowledge of the fundamental process on which his craft depends, this treatise on steel making will be interesting and useful. It takes up, however, over two-thirds of the book, leaving only one chapter, less than one-sixth of the book, for molding, pouring and digging out, with the same space for heat-treatment and annealing, and only four pages for finishing, straightening and welding.

With this division of space it is evident that the art of the steel-foundryman is but briefly treated. We should have liked to see Mr. Hall reverse the proportions of his dosage and apply his wide knowledge of the steel foundry to giving a more complete analysis and exposition of the steel-founder's craft.

One point which requires further consideration is his statement that cracks are favored by low carbon, an analysis which gives the maximum shrinkage. In order to make the matter complete, mention should be made of the fact that in castings of heavy section the change of volume while passing through the critical range may have an important influence on cracking. The matter is undobtedly complex and deserves detailed consideration. Let us hope that an early call for a third edition will give Mr. Hall occasion thus to increase our indebtedness to him.

The present tendency to increase continually the intricacy of the forms of steel castings would make a thorough study of the principles of molding and casting of great value. Not only would this be of direct aid to the foundryman, but it would help him in enlightening those for whom he works—the designers of steel castings. The manager of a successful steel foundry recently expressed the hope that a particularly warm corner of the hereafter would be reserved for the designers of modern steel castings for locomotives. It would be a pleasant thing to have a treatise on foundry practice to offer as a shorter catechism to save these brands from the burning. Full utilization of the possibilities made available by progress in the art of casting steel can be attained only by having considerable knowledge of the difficulties and the limitations of the art. This phase of the subject is somewhat neglected by Mr. Hall. What he gives makes us wish for more.

LAWFORD H. FRY.

HANDBOOK OF PETROLEUM, ASPHALT AND NATURAL GAS. By *Roy Cross*. 625 pp. Published as Bulletin 16 of Kansas City Testing Laboratory (Kansas City, Mo.). Price, $7.50.

Those in the petroleum industry who in the past have profited from the usefulness of this bulletin's predecessors will need no elucidation of its purpose. Others may be interested in the prefatory note to Bulletin 15: "The purpose of this publication is to set forth in concise form for the petroleum producer, seller, refiner and technologist the scientific information and statistics on the production, properties, handling, refining and methods of evaluating petroleum and related products." In addition to the sort of material usually found in handbooks, the technical man will find of value the descriptive chapters on petroleum refining, including

cracking, transportation, storage and gaging, general and chemical constitution of petroleum as well as the standardized and commercial methods of analysis. In the chapter on refining the author includes a detailed description of the decomposition of petroleum hydrocarbons in the presence of aluminum chloride. This review of the subject, together with the list of important references, is a real contribution to the literature.

Other new matter appearing in this bulletin includes tables and formulas for gaging the capacity of horizontal cylindrical tanks with "bumped" ends, methods for determining the capacity of oil pipe lines, details of refining and cracking costs, specifications and properties of petroleum products and the vapor volumes of distillates of different gravities at varying temperatures. A feature worthy of mention is the compilation and classification of United States patents on petroleum processes from 1850 to January, 1922.

The handbook is attractively bound in a black flexible cover and by means of its loose leaf binding it is possible to insert such new matter as is occasionally issued by the publishers.

S. D. KIRKPATRICK.

HANDBOOK OF CHEMICAL ENGINEERING. Prepared by a staff of specialists. *Donald M. Liddell*, editor-in-chief. 2 vols. Published by McGraw-Hill Co., New York. Price $8.

A pioneer book is always an experiment and its success depends upon many factors. The reviewer is concerned with only two of them. First, is it a good book and second, is it well printed? Now the "Handbook of Chemical Engineering" is well printed, but I promised myself the satisfaction of protesting against the occasional and apparently unnecessary transition from large to small type at various points in the text.

This book had a hard job when it came to my desk. It had been heard of some time ago and was being awaited with interest, so it had to take a rather stiff hurdle of standard. The Lord knows, and every chemical engineer knows, that it was needed badly. Before we go any further I want to make one thing clear. The book is a milestone in chemical engineering. It is not only a milestone, it is a splendid work and a real achievement. I read it, enjoyed it, found much profit in it and intend to keep it for reference.

If you were faced with the task of compiling a handbook of chemical engineering, what would you do? The reviewer would have done exactly what Mr. Liddell did—"analyzed chemical industries and selected the features essential to most of them for description." Thus the selection of subjects would be the first bone of contention, and so we shall discuss that first. Here is Mr. Liddell's list in the order in which they appear:

I, Generation and Transmission of Power. II, Material Handling—Transportation of Solids. III, Transportation of Liquids. IV, Transportation of Gases. V, Crushing and Grounding. VI, Grading (Sizing and Screening). VII, Mechanical Separation. VIII, Concentration. IX, Leaching and Dissolving. X, Evaporating and Drying. XI, Crystallization. XII, Thermometry and Pyrometry. XIII, Refractories. XIV, High-Temperature Production. XV, Mixing and Kneading. XVI, Sampling. XVII, Fermentation. XVIII, Distillation, Fractional and Destructive. XIX, Refrigeration. XX, Oxidation and Reduction. XXI, Electrochemistry. XXII, Catalysis. XXIII, Colloidal Chemistry. XXIV, Smelting —Zinc — Lead — Copper — Iron — Roasting. XXV, Lutes and Cements. XXVI, Radioactive Elements. XXVII, Rare Metals. XXVIII, Rare Gases. XXIX, Materials of Construction. XXX, Plant Design. XXXI, Method of Financing.

Comprehensive! That is the first reaction. Thus it would be for sins of commission rather than those of omission that the editor might be liable. That is in itself a recommendation. Every subject is there that should be, but there are some subjects which are not extremely relevant to chemical engineering. It is difficult, perhaps impossible, to draw the line, and much better to include than omit. The editor's predilection for metallurgy has given somewhat elaborate treatment to certain subjects which are of primary or sole interest to the metallurgical engineer. Chapter VIII, on Concentration (in the metallurgical sense), and Chapter XXIV, on Smelting and Roasting, are examples. It is perhaps a legitimate query whether a handbook of chemical engineering should carry these subjects. So too the treatment of Mechanical Separation (Chapter VII) and of Sampling (Chapter XVI) have a distinct metallurgical balance. A different emphasis would have been better. Again, Chapters XXVI and XXVIII, on Radioactive Elements and Rare Gases, are defended by the author specifically, but while the essays are most interesting, I question their inclusion under chemical engineering.

Finally, Chapter XXXI, on Methods of Financing, is a correct gesture in that it emphasizes the necessity of familiarity with the "business side of chemical manufacturing," but it is only one of half a dozen equally important subjects, all of which should be discussed if that phase is to have emphasis. It could have been omitted without diminishing the value of the book as a handbook of chemical engineering, and should have been omitted.

Perhaps it is also legitimate to suggest that future editions would be improved by a grouping of subjects under several general headings which suggest themselves. The present order of discussion is rather random when it does not need to be.

It is inevitable that with thirty-one contributors, the points of view toward subjects will vary with temperament and experience all the way from theoretical thermodynamic treatment to scientific co-ordination of practical data. In general the treatment is distinguished, as would be expected from the high caliber of the contributors. But the fact that one rather expects some variation in method of treatment does not eliminate a cretain disappointment at the unevenness. The editor himself has handled his subjects splendidly, almost ideally. In some of the articles there is an unfortunate lack of contact with plant practice. The authors treat the subject adequately from a theoretical standpoint, but when it comes to giving the basis for making plant installations they fall down. This is the exception, however, for in general the treatment of this phase is able and there is focussed on the many subjects an almost unique experience in that field.

It is not inappropriate for us to evaluate some of the chapters where this evaluation will be instructive. The Generation and Transmission of Power is a very meaty article. Perhaps the subject lends itself better than some to a quantitative study, but it is of unusual value and interest. The next three chapters, on the Transportation of Solids, Liquids and Gases, are likewise substantial. Perhaps the discussion of Oxidation and Reduction is more disappointing to the technical man than any other. A very adequate theoretical discussion but no technological information is given and such an important oxidizer as manganese dioxide is not even mentioned. In happy contrast is the next article, on Electrolysis (by the editor himself). It is a fund of invaluable information about plant practice. Catalysis is excellently treated, while Colloids, though interesting, is filled with much irrelevant material and there seems to be a desire on the part of the author to make you say "Oh, my!" Fractional Distillation is discussed from a theoretical standpoint and the reader would find a good deal of trouble in building a still from the data offered. The chapter on Plant Design escapes more than half the problem by conveniently distinguishing between machine design and plant design. The discussion of the economics and geography of the subject is interesting but not nearly as vital as the discarded half of the subject. There are many plants which have violated every principle developed in the article and still have been successful. "Machine design" is an essential part of plant design in the chemical field and there are many generalizations which would have been helpful. Materials of Construction was also a little disappointing and the lengthy report on portland cement seems unnecessary.

Future editions will rectify these faults, which are all relatively minor troubles. Meanwhile here is the first edition. The question for chemical engineers is really, Can I afford to be without this book? My answer is, No! And I should like to extend to Mr. Liddell my congratulations for a piece of work that is—memorable!

CHARLES WADSWORTH.

Recent Chemical & Metallurgical Patents

Production of Cyanamide From Calcium Cyanamide—J. H. Lidholm, of Sweden, had already patented (U. S. Pat. 1,380,223) a process for adding calcium cyanamide to the water simultaneously with the addition of carbon dioxide for precipitating calcium as carbonate. In this way the production of dicyandiamide is avoided. It has since been found, however, that a regulation of the alkalinity must be made to below 0.5 normal and at a temperature of roughly 30 deg. C. By keeping the temperature slightly above 30 deg. C. the precipitation of cyanimide carbonate is avoided. In this way a very nearly theoretically perfect production of cyanamide from calcium cyanamide can be obtained. (1,280,223. Nov. 21, 1922.)

Process for the Production of Hydrogen Sulphide—Henry Howard, assignor to the Grasselli Chemical Co., has invented a process for the production of hydrogen sulphide. It consists essentially in the use of zinc sulphide ores and sulphuric acid, and produces zinc sulphate and hydrogen sulphide. It differs from the so-called Christensen process, in which the same reaction is employed, in the volume of sulphuric acid used and in the fine division of the sulphide ore. Christensen used large volumes of sulphuric acid in order to dissolve the zinc sulphate as it was formed. The author of this process uses a very finely divided zinc sulphide (which passes through 200 mesh) and agitates this in about five volumes of sulphuric acid, although the actual ratio of acid to ore may vary over a considerable range. After the batch has been completed, one-half of the acid may be recovered and used again. (1,435,471. Nov. 14, 1922.)

Manufacture of Vulcanized Rubber Articles—M. H. Harrison and Harold A. Morton, of Akron, Ohio, have assigned to the Miller Rubber Co. the following patent for the manufacture of vulcanized rubber. The objection to present processes for making rubber mixes is that on the calender rolls, which are so geared that they operate at differential speed, considerable heat is generated, and vulcanization either in whole or in part takes place on the rolls themselves. This ruins the batches of rubber. To avoid this the authors suggest making two separate mixes, one of the rubber with zinc oxide and sulphur, the other with the rubber, zinc oxide and the organic accelerator. When these sheets have been rolled to a thickness of 0.015 in., it is possible to pile them up one on top of the other and to vulcanize the pile perfectly. Thus no loss is entailed due to the earlier vulcanization. (1,434,892. Nov. 7, 1922.)

American Patents

Issued Nov. 28, 1922

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,436,739—Evaporator.
1,436,819—Diolefines.
1,436,820—Manufacture of Paint.
1,436,940—Separation of Chloracetones.
1,436,949—Production of Ammonia.
1,437,041—Nitration of Cellulose.
1,437,045—Manufacture of Motor Fuel.
1,437,101—Recovery of Gasoline.
1,437,102—Recovery of Gasoline.
1,437,191—Elimination of Phosphorus.
1,437,292—Distillation of Carbonaceous Materials.

Complete specifications of any United States patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Catalyzer and Method of Producing the Same—W. D. Richardson, assignor to Swift & Co., has developed a method of producing a more efficient nickel catalyst by abrading crude nickel in the presence of water. The present method consists of grinding the nickel in the presence of oil to be hydrogenated. By this new process nickel is put into a ball mill in reasonably large lumps, either with or without an abrasive material, and the whole is ground to roughly 200 mesh in the presence of water. Then it becomes necessary to dry the mud thus produced and grind again the nickel catalyst with oil, inasmuch as water is a dilatory substance to the hydrogenation process. The greater efficiency of the nickel produced by water abrasion is given as a reason for adopting the extra processing. (1,419,986. June 20, 1922.)

The Use of Vanadium Oxide as a Catalyst—C. H. McDowell, H. H. Meyers and (in the case of patent 1,420,201) Warren B. Pattison have assigned their patents on the production and use of vanadium oxide as a catalyst to the Armour Fertilizer Works. Patent 1,420,203 has to do with the production of the catalyst. Alumina from the mineral alunite is used as a carrier for the vanadium and, for example in the case of sulphuric acid, can oxidize from 50 to 60 per cent of the sulphur dioxide to sulphur trioxide. In the presence of about one part of vanadium oxide to ten parts of alumina, a conversion of better than 87 per cent is obtained. In preparing the catalyst, ten parts of ammonium vanadate is added to about one hundred parts of alumina from alunite. The mixture is moistened enough to permit molding and briquets of suitable shapes are then prepared with just enough pressure to bind the material together. The heating of the dried briquet must be comparatively slow, but they are very durable if the heating is carried out carefully. Catalysts so prepared may be used as in patent 1,420,201 for the oxidation of ammonia, or as in patent 1,420,202 for the oxidation of sulphur dioxide in the preparation of sulphuric acid. Various temperatures and other conditions necessary to carry out the reactions are described in detail in the patents. (1,420,201; 1,420,202 and 1,420,203. June 20, 1922.)

Preparing Pigment Suspensions—George W. Acheson, of Newark, N. J., has been granted a patent for a process of preparing pigment suspensions in oil to be used in the manufacture of paints, inks, varnishes and similar products, consisting of a pigment and a vehicle. As a typical example of how the invention is carried out the author takes a suitable pigment such as ultramarine, zinc white or carbon black, and deflocculates it according to the known process whereby it is wholly or partly converted into a colloidal condition. The resulting paste is thinned with water to the consistency of a thin cream. This is then poured with stirring into the vehicle, which may, for example, be boiled linseed oil or a hydrocarbon oil of the paraffine type. To the pigment-oil-water mixture or emulsion is then added a small portion of some flocculating electrolyte, such as a solution of alum or dilute hydrochloric acid. After stirring, the mixture is permitted to stand until a curdlike precipitate or deposit is formed. These curds consist chiefly of oil and pigment from which the bulk of the water has been eliminated. Excess water may be drained off or can be evaporated as, for instance, by passing the mass through steam-heated rolls. The resulting product is then ready for shipment. (1,431,-079. Assigned to Acheson Corporation of New York. Oct. 3, 1922.)

Acetaldehye From Acetylene—In the synthetic production of acetaldehyde a current of acetylene is passed over the mercuric salt in an acid medium. The activity of the mercuric catalyzer rapidly diminishes and the absorption of the acetylene becomes proportionately lower, finally stopping completely when the mercuric salt is reduced to the state of a grayish powder. The problem then is to regenerate this mercuric salt by oxidation. In the present patent, L. E. M. Trevoux of Petit-Quevilly, France, maintains the activity of the catalyzing agent by adding an oxidizing substance such as ferric oxide. When in turn the oxidizing agent is exhausted, the liquid is decanted and the ferric salt is again generated by boiling with nitric acid

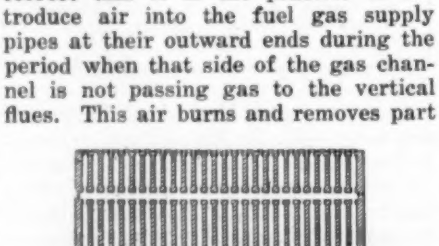
or preferably by electrolysis. It is this electrolytic oxidation that forms the principal feature in the patent. (1,428,-668. Assigned to La Société Anonyme de Produits Chimiques Establissements Maletra, of Petit-Quevilly, France. Sept. 12, 1922.)

Electric Furnace—O. A. Colby, of Irwin, Pa., has patented a crucible furnace, wherein the crucible is built up of alundum, sintered in place, resting on a resistor made of carborundum blocks. Current is led in by massive graphite blocks. Contacts at each end of the carborundum resistor is made by a packing of granular graphite. Through the brickwork surrounding the crucible, and at each end of the resistor, is provided a well or hopper, which is kept packed with this granular graphite, periodically replenishing that which is burned. These essential parts of the furnace are encased in refractory firebrick and insulating material, the whole bound with steel plates and mounted on trunnions. (1,435,211, Nov. 14, 1922. Assigned to Westinghouse E. & M. Co.)

The Solidifying of Sulphur—Present practice in the sulphur field consists of pumping molten sulphur from the pipes as it comes to the surface of the ground into a large area, roughly hundreds of feet square, and from 15 to 20 ft. high. The sulphur solidifies finally into a large mass or block, and it takes sometimes as long as 2 months for the material to solidify completely. Then it must be blasted down, much as rock is blasted, before it can be loaded into cars. The present invention has for its purpose the solidifying of sulphur in such a manner that it can be loaded directly into cars and does not have to be stored over long periods of time. It consists essentially of a belt conveyor, on which the sulphur is run to a definite thickness of layer. This layer solidifies very rapidly, since it is comparatively thin. Another layer is then superimposed immediately upon the solidifying of the first layer, and this process is continued as the belt slowly moves forward. A thickness of cake can be built up to any desired dimensions, depending on the length of the belt, and as the cake comes off the end of the belt, it can be broken up to any desired size for immediate shipment. (1,419,911. Raymond F. and Harold S. Davis of Pittsburgh, assignors to the Texas Gulf Sulphur Co. June 20, 1922.)

Recovery of Oxides of Nitrogen in Sulphuric Acid Manufacture—In the chamber or tower processes for the manufacture of sulphuric acid, oxides of nitrogen are added to sulphur dioxide, and with the addition of steam they produce sulphuric acid. These oxides of nitrogen are later absorbed in a reduced condition in the Gay-Lussac tower by means of a downcoming stream of cold, fairly concentrated sulphuric acid. If a very small quantity of sulphur dioxide, approximately 0.10 per cent, is present, the absorption takes place with greater rapidity than in its absence. This was developed by the author in patent 1,205,723. It was found, however, that the gases which escape from the Gay-Lussac tower could not be absorbed readily in the presence of this small quantity of sulphur dioxide in the ordinary water scrubbers, because the presence of sulphur dioxide prevented the re-oxidation of the oxides of nitrogen to the higher and soluble oxides. In order to obtain as efficient an absorption of oxides of nitrogen in the Gay-Lussac tower, and in addition, to recover all the oxides of nitrogen, the absorption is carried out in the presence of a small quantity of sulphur dioxide, after which the gases emerging from the Gay-Lussac tower are run through milk of lime scrubbers, which removes the sulphur dioxide and permits the subsequent oxidation of the oxides of nitrogen to the higher oxides, which are then removed in ordinary water scrubbers. Several other systems of recovery are possible, and are detailed at some length in the patent, all of them having to do with the fundamental problem of attaining the higher oxides of nitrogen for absorption in water in some way or other. (1,420,-477. Andrew M. Fairlie, of Atlanta, Ga. June 20, 1922.)

Coke-Oven Decarbonization—All coke ovens of the vertical flue regenerative type are troubled with more or less carbonization of the fuel gas nozzles. To correct this it is the practice to introduce air into the fuel gas supply pipes at their outward ends during the period when that side of the gas channel is not passing gas to the vertical flues. This air burns and removes part



of the carbon. Due to the serious cooling effect and consequent cracking of brickwork, which a large quantity of this cool air causes, it is not possible to burn off all the carbon in this manner, and resort must be had to punching out the nozzles from the inspection holes above, which is costly and laborious.

In this invention, decarbonizing air is supplied to the inner ends (in the center of the oven). This preheats the air and thus a sufficient quantity can be introduced without danger of cracking the brickwork to decarbonize the nozzles completely. Also, the nozzles which carbonize worst are in the center of the oven and these receive the supply of decarbonizing air first. The accompanying figure shows the general layout of air passages to suit this invention. (1,435,361. Louis Wilputte, assignor of two-third to Alice A. Wilputte. Nov. 14, 1922.)

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Purifying Acetylene — Phosphorus compounds in acetylene are oxidized to phosphorous acid and removed as such by treatment with oxygen, preferably at a raised temperature, in the presence of activated charcoal as catalyst. Acetylene mixed with a small proportion of oxygen or air is passed through a reaction tower packed with activated charcoal and heated to 80 to 100 deg. C.; alternatively, acetylene and air are passed in succession over the charcoal. Phosphorous acid is recovered by extracting the charcoal with hot water. (Br. Pat. 184,184; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Oct. 4, 1922.)

Artificial Silk—To obtain non-tarnished films, artificial threads and other articles capable of taking a dye, from cellulose nitrate, acetate, butyrate and other esters of cellulose, there is added to a solution of the ester in a relatively volatile organic solvent a small quantity of a non-volatile organic solvent soluble in water. After forming the thread or film, by the evaporation of the volatile solvent, the non-volatile solvent is extracted by washing with water. As non-volatile solvent formamide, acetamide, chloral, and chloral hydrate are employed. The volatile solvent may be methyl, ethyl, butyl or amyl formate or acetate, together with methyl or ethyl alcohol. (Br. Pat. 184,197. J. Duclaux, Paris. Oct. 4, 1922.)

Alkali Phosphates—Mineral or precipitated calcium phosphate or bone ash is mixed with a solution of sodium potassium or ammonium sulphate and the product treated with sulphur dioxide. The reaction products are calcium sulphate and a soluble phosphate corresponding to the sulphate used, a soluble sulphite being also formed when tricalcium phosphate is treated. The formation of sulphite can be avoided if one of the three molecules of sulphate required for the reaction is replaced by one of sulphuric acid, and this may be accomplished, in the case of sodium phosphate, by the use of niter cake. No sulphite is formed when precipitated calcium hydrogen phosphate is treated, and in this case the sulphur dioxide can be recovered by heating the filtered reaction liquid. Other acids readily volatile from hot solutions, such as acetic or formic acid, or carbon dioxide, or hydrogen sulphide, may replace sulphur dioxide. (Br. Pat. 184,206. J. G. Williams, West Bridgford, Nottinghamshire. Oct. 4, 1922.)

Sweetening Gasoline — The desulphurization of liquid hydrocarbons, such as kerosene, benzine or shale oil, by treatment with alkaline hypochlorite, such as sodium hypochlorite, with free alkali is preceded, followed or both preceded and followed by treatment with alkali. The treatment may be effected in a vessel in which brine is being electrolyzed for the production of sodium hypochlorite, and the temperature may

be raised to, say, 120 deg. F. The product may be filtered through animal charcoal, fullers earth, dehydrated alumina or other adsorbent substance. (Br. Pat. 184,281. A. E. Dunstan, Sunbury-on-Thames. Oct. 4, 1922.)

Aromatic Amines—Aromatic amines are obtained by heating unsubstituted phenols with a mixture of ammonia, an ammonium salt other than sulphite and an alkali sulphite. The alkali sulphite may be that contained in the crude melt resulting in the preparation of the phenol from the corresponding sulphonic acid by alkali fusion. An example is given of the preparation of beta-naphthylamine. (Br. Pat. 184,284. W. L. Galbraith, W. V. Shannan, W. G. Adam and N. E. Siderfin. London. Oct. 4, 1922.)

Tungsten Filaments—Drawn tungsten filaments are produced from materials in which uranium oxide, or a substance that will yield uranium oxide in the subsequent treatment, is incorporated. The substance may be incorporated with unreduced tungstic oxide or with the reduced tungsten powder. It may be added as a solution of uranium nitrate, which is converted by subsequent heat-treatment into the oxide. Other substances—for example thorium oxide or boric acid or both—may also be present in the tungsten material. The tungsten material described in specification 155,851 may be used. (Br. Pat. 184,291. W. H. Le Maréchal, London. Oct. 4, 1922.)

Synthetic Resins — Synthetic resins obtained by the condensation or polymerization of aldehydes with alkali are rendered stable toward water by treating them in a state of fine subdivision with water, to which a little acid is preferably added. The products are soluble in fatty oil, spirit, benzene and other solvents used in the manufacture of varnishes; by rolling in the soft state they can be converted into the commercial form of sheet shellac. According to the example, the resin resulting from the condensation or polymerization of acetaldehyde is ground in a ball mill with a 3 per cent aqueous solution of acetic acid, the product filtered off and either melted or dissolved in a spirit or oil solvent. (Br. Pat. 184,442; not yet accepted. Consortium für Elektrochemische Industrie Ges., Munich. Oct. 4, 1922.)

Synopsis of Recent Chemical & Metallurgical Literature

Eliminating Static Electricity

The variety of circumstances under which static electricity is produced is surprising, and causes trouble in many chemical industries. In this connection the Bureau of Standards has prepared for publication, in the journal of the National Association of Dyers and Cleaners, a brief account of the sources of static electricity and some suggested means of avoiding it.

In general appreciable charges of static electricity can be produced only when the surrounding air is very dry, and static troubles almost never occur when the relative humidity is greater than 70 per cent. Consequently, the use of damp atmospheres, obtained, for instance, by injecting steam into the room, is one simple and effective means of combating the evil. Another precaution is to connect all metal parts of machinery together by substantial wires so that no difference in electrical potential can be produced between the various parts.

Fusion Rotary Retort

C. J. Goodwin, speaking before the South Wales Institution of Engineers, described the fusion retort and the principles underlying its design and operation. This device is planned for the recovery of oil from coal shale or like substances, which for effective work in this apparatus must be reduced to fine size in order to increase the oil yield, permit lower retort temperatures and insure more complete utilization of the raw material than is possible if the undersize pieces have to be rejected.

For successful retort operation the thickness of layer in contact with the retort should be a minimum and this material should be turned over frequently while being gradually increased in temperature so that the heated surfaces are free from caked material. The fusion retort accomplishes the stirring by rotation of the retort and use of a loose "star" or "cross" breaker. This breaker rolls in the retort when this is rotated, falling back from one edge to another with a chipping or hammering action that is intended to prevent a caking of the material on the inner shell of the retort. With a six-point star it is claimed that the noise and power consumption are sufficiently low to avoid any difficulty. The general character of the retort is shown in the illustration herewith.

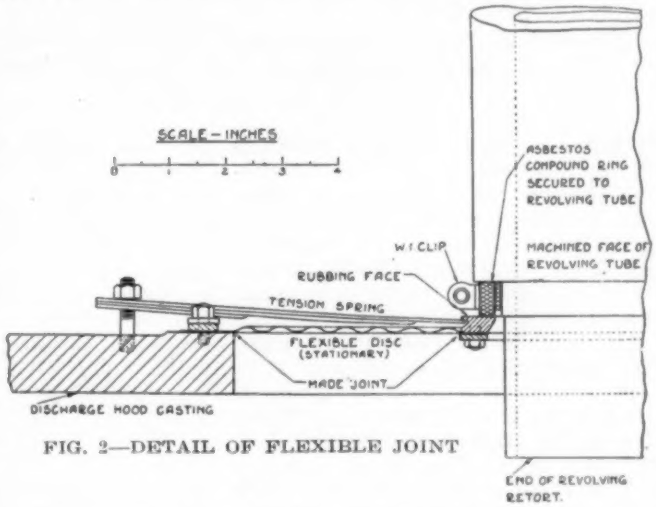


FIG. 2—DETAIL OF FLEXIBLE JOINT

The use of the rotary retort requires a gas-tight flexible joint at the ends. This feature of the construction is one of the most difficult. The form of flexible joint recommended is shown in Fig. 2. It is claimed that this retort has low first cost, low upkeep cost, low power requirement for operation and minimum contact of gas and oil vapor with hot surfaces. By progressive advance of the material through the retort, preliminary eduction of moisture is accomplished and desirable heating up of the solid to be retorted is insured.

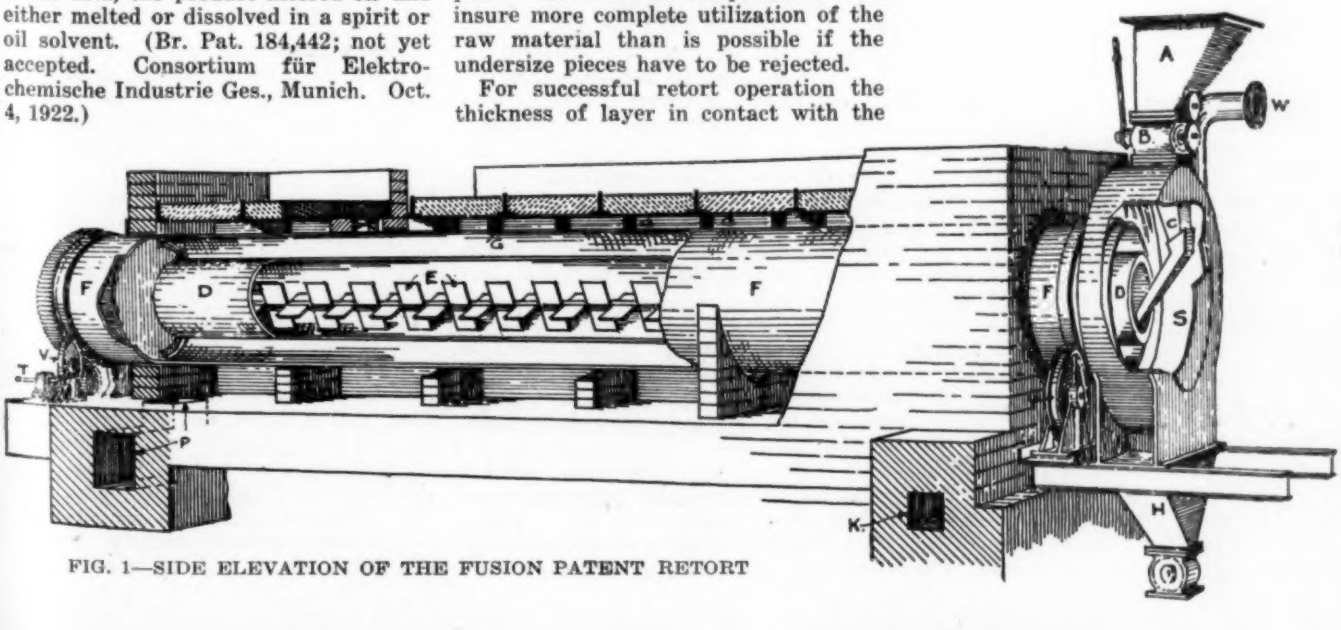


FIG. 1—SIDE ELEVATION OF THE FUSION PATENT RETORT

Technical News of the Week

Current Events in the Chemical, Metallurgical and Allied Industrial Fields
Legislative Developments—Activities of Government Bureaus, Technical Societies and Trade Associations

Interdependence of Economics and Engineering Keynote of A.S.M.E. Convention

Forty-third Annual Convention of American Society of Mechanical Engineers Attracts Two Thousand Members and Guests to New York

THE American Society of Mechanical Engineers gathered in convention at their New York headquarters Dec. 4 to 7 for a 3-day session of marked success, about 2,000 members and guests being registered. Following the usual custom of the society, the first business on the program was the election of officers for the ensuing year, which resulted as follows:

President, John L. Harrington, of Kansas City; vice-presidents, W. H. Kenerson of Brown University, Earl F. Scott of Atlanta, Henry H. Vaughan of Montreal and W. S. Finlay of New York City; managers, A. G. Christie of Johns Hopkins, J. H. Herron of Cleveland and Roy V. Wright of New York; secretary and treasurer, W. H. Wiley of New York.

Engineer Should Lead Nation

At the opening session, Dean Dexter S. Kimball of Cornell, the retiring president, made an address in which he urged that some change be made in our industrial system so that a more equitable distribution of the fruits of industry might be obtained. Otherwise, he feared that our present civilization can not endure. Dean Kimball said that engineers must take a more prominent place in control of national affairs, and closed his speech with the following inspiring words:

"The scientific mind is capable of high development along business and financial lines, while yet retaining in its background the powerful scientific methods of attacking problems which have made modern industry possible. And this is the great contribution that the engineer can bring to the problem of universal well-being. The one great thing we are all seeking is justice; but there is no justice where there is no knowledge, and the engineer, again using this term in its widest sense, alone possesses an accurate and intimate knowledge of industry."

Engineering and Economics

The keynote of the convention was sounded on the evening of Dec. 6 when, in a joint session of the A.S.M.E. and the American Economic Association, plans were laid for a closer co-operation between engineers and economists. The principal speaker at this meeting, Dr. Wesley C. Mitchell, director of the National Bureau of Economic Research, pointed out that both the engineers and economists had much to learn from each other, and that, if the principles of economics could be applied by the practical methods of engineers, the true end of all industry —the improvement of the condition of the human race—would come much nearer to realization than at present.

Other speakers at this meeting included H. R. Seager, president of the American Economic Association; E. F. DuBrul, of the Machine Tool Manufacturers' Association; E. M. Herr, president of the Westinghouse Electric & Manufacturing Co., and Dean Kimball, retiring president of the A.S.M.E. It was brought out in the remarks of all these speakers that a vastly greater amount of education, especially along economic lines, was necessary for all, so that we may understand the underlying reasons for industrial conditions, work together for the improvement of these conditions and obtain greater justice and well-being for all.

Pan-American Development

Calvin W. Rice, secretary of the society, who has just returned from South America, where he attended the Brazilian Centennial Exposition at Rio de Janeiro, declared that through the efforts of the engineering profession a new era is dawning for Pan-America. As the envoy of many of the largest engineering organizations in the United States Mr. Rice participated in the International Engineering Congress at Rio, and, with the support of Secretaries Hughes and Hoover and other leading figures in Pan-American development, made a tour of South and Central America.

In Mr. Rice's address, delivered in the nature of a report to the engineers of the nation, announcement was made of the definite accomplishment of three steps in the movement toward the unity of the Americas:

(1) Action has been taken toward effecting a permanent organization to carry out the plans of the Rio congress, with Verne L. Havens of the McGraw-Hill Co., New York, as secretary.

(2) A standardization bureau, as suggested by Secretary Hoover, will be established in every Pan-American country.

(3) The dream of a transcontinental railway is approaching the stage of reality. A meeting to further this project will be called by the nations of Pan-America. Minor C. Keith of Costa Rica, the only living member of the committee that originally recommended the building of this railway, has been asked to preside.

Technical Sessions

The technical sessions were of great interest and were enthusiastically supported. Among the general topics treated were management, material handling, machine shop practice, refrigeration, education and training for industry, research, fuel engineering, steam power engineering, railroad engineering safety, standardization, ordnance, aeronautics, forest products, the power test code, and the boiler code.

L. P. Breckenridge, of Yale University, presided at a joint session of the fuels division of the society and the Stoker Manufacturers' Association. The fuels division has prepared a set of rules for householders governing use of fuel, management of furnace and the burning of substitutes for anthracite. Economy must be practiced by every consumer, the division warned, if an acute shortage is to be averted.

Helium Hearings Begin Before Public Lands Committee

The Committee on Public Lands on Dec. 5 began hearings on the helium bill. The only witness who has appeared at the time of this writing is R. B. Moore, chief chemist of the Bureau of Mines. At the request of the committee, Dr. Moore is explaining to the committee the full history of helium development. This will be completed before the bill itself is taken up. The committee feels that the subject is of sufficient importance that its members should have a clear picture of all the considerations involved in the whole subject of helium.

The committee is much impressed with the widespread sentiment manifested in many sections of the country for the helium bill. This was supplemented by a formal request from the Federated American Engineering Societies asking that hearings begin at this time. In view of this demonstration of interest among engineers and the public generally, the committee voted to begin the hearings at once.

Government Departments Report Year's Work

Active Development of Mineral Wealth Described in Bureau of Mines Report

A SUBSTANTIAL beginning of the active development of that vast mineral wealth which has heretofore been locked up in the public domain of various Western states, but which is now to be liberated under the terms of the general leasing law, has been made, according to H. Foster Bain, director of the Bureau of Mines, in his annual report just submitted to the Secretary of the Interior. In the fiscal year ended June 30, 1922, there was produced from government lands other than Indian lands, 18,236,362 bbl. of petroleum, of which the federal government received as royalty 3,616,852 bbl. worth $4,768,397.61, not including bonuses. In addition, at the end of the year $14,000 a month was being received by the government from natural gas leases on public lands in Wyoming. In the Rocky Mountain field alone there were on government land 336 oil wells, of which 267 were in the Salt Creek, Wyo., field. A hundred other wells were being drilled.

Up to the end of the year there had been issued 294 oil and gas leases in 4 states and 7,727 prospecting permits, on each of which drilling is required, in 18 states and Alaska. These figures do not include operations within the naval petroleum reserves, which by executive order are now administered by the Bureau of Mines. The field work is directed through a supervisor who has headquarters at Denver with branch offices at Casper and Salt Creek in Wyoming, Bakersfield, Taft and Maricopa in California, Winnett, Mont., and Shreveport, La.

Survey of Government Oil Wells

The largest number of producing wells belonging to the government is in the Salt Creek field of Wyoming, where the government holds title to nearly all the land. During the year the producing capacity of the wells far outran the capacity of existing pipe lines.

In California the principal activity has been with regard to leases within the naval petroleum reserves. The year marked final adjudication of the most important outstanding contest as to oil lands, that of the Honolulu Consolidated Co. Leases were granted by the Secretary of the Interior and accepted by the company and a drilling campaign promptly arranged. A careful study made by the Bureau of Mines brought out the fact that up to March 4, 1922, the government lands had lost by drainage approximately 22,000,000 bbl. of oil through failure to drill offset wells. Of this, on the scale now in effect, the government's loss in royalty may be estimated at 6,800,000 bbl., equivalent to $8,800,000. To prevent further losses, leases were accordingly granted to such lands as were being

(Continued on page 1192)

Fries Commends Personnel in Report of Chemical Warfare Service

THE WORK of the Chemical Warfare Service during the last fiscal year is reviewed in detail by General Fries in his annual report. The report itself covers thirty-nine pages. General Fries emphasized as the predominant impression the loyal and efficient manner in which the personnel have performed their duties under the stress of emergency work and the ever-present uncertainty as regards the continuance of the Chemical Warfare Service.

"This latter situation is a matter of real importance," says the report. "With the action of the Limitation of Armaments Conference, followed later by evident indications that the appropriation for this service would be very much curtailed, a large proportion of the civilian personnel has been confronted with the problem of seeking employment elsewhere at some indefinite future date.

"The organization has been built up carefully, and this has resulted in personnel of much training and valuable experience severing their previous connections and becoming definitely identified with this work. That these uncertain conditions did not effect the morale of the organization greatly is due to the high character and real interest of these people in their work. It cannot be urged too strongly that efforts be made to have definite policies established regarding the activities to be carried on by the Chemical Warfare Service. The personnel must know where it stands.

Service a Necessity

"The close of another fiscal year, with its attendant experiences and knowledge gained, leaves a keener and more definite realization of the importance and necessity for chemical preparedness. In any consideration of policies pertaining to the national defense, the field of chemistry dare not be neglected. Certainly investigations into the possibilities of chemical warfare must be continued and as information is obtained it must be made available to the army and navy and incorporated in plans and training.

Efforts of Past Year

"The year ended June 30, 1922, was noteworthy in many respects as regards chemical warfare. One of the outstanding features was the growing appreciation of the range covered by chemical warfare, and its usefulness in peace as well as in war. The rôle which chemical warfare must play in defense alone is a vast one and entitles it to the serious consideration of every student of defense.

"The use of smoke and incendiary materials for the purpose of screening

(Continued on page 1192)

C. W. S. Appropriation Cut

The Director of the Budget has approved an appropriation of $482,240 for the Chemical Warfare Service for the next fiscal year. This is a reduction of $135,000, the amount appropriated for the current fiscal year.

Will Attempt to Have Budget Enlarged

Cut in Budget Affects Salaries of Chemical Engineers

During this fiscal year the Chemical Warfare Service is expending $600,000 for the purchase, manufacture and test of chemical warfare gases or other toxic substances, for gas masks and other offensive and defensive materials and appliances. Out of that amount the service is expected to pay for all necessary investigations, experiments and research work. The purchase of chemicals and all scientific and technical apparatus and instruments must be taken from the same appropriation. It also is to include the miscellaneous operating expenses and the salaries of personnel.

A large portion of the decrease, upon which the Director of the Budget insisted, is being made in the salaries of the higher grade members of the staff. For instance, during the last fiscal year six chemical engineers of the $4,500 grade were allowed. This was reduced to three during the current fiscal year. During the next fiscal year no engineers of that grade are to be employed. The four associate chemical engineers of the $3,600 grade, which were allowed during the last fiscal year, are not provided for in the new budget. The highest salary allowed a chemical engineer is $2,800 and only one of that grade is provided.

At the sacrifice of a number of subordinate chemical positions, the number of principal chemists of the $6,000 grade has been increased from four to nine. During the current fiscal year six assistant chemists were provided. The Director of the Budget has approved an additional assistant chemist of the $2,500 grade for the next fiscal year. The new budget makes provision for one mechanical engineer at $3,600. The safety engineer formerly employed is dropped, as are the chemical laboratorians, the pathologists, the physiologists, the technical adviser, the technical patent expert, the associate and assistant technologists, and the toxicologists.

The friends of the Chemical Warfare Service in Congress will make a determined effort to override the Director of the Budget in the matter of Chemical Warfare Service appropriations. There is reason to believe that Congress will be convinced that the appropriation allowed by the Budget Bureau is inadequate and that an increase will be carried in the appropriation bill.

Equipment Association Begins Work

Opens National Offices in New York City and Launches Important Activities

The Chemical Equipment Association, comprising manufacturers of equipment essential to the chemically controlled industries has established national executive offices at 1328 Broadway, New York City. It has begun active work through a national membership for the fostering of trade in chemical equipment; for the improvement of practices in the production and distribution of such equipment, and in the performing of engineering services incidental thereto.

Not only does the activity of this association signalize the adoption of trade association methods by the chemical equipment companies, but it represents a movement toward manufacturing and distributing co-operation along the lines recommended by Secretary of Commerce Hoover, who personally encouraged the organization of the association. Commenting on the growing tendency toward co-operative associations, the New York *Tribune* in its issue of Nov. 5 quoted an officer of the Chamber of Commerce of the United States as follows:

> Such supply company organizations as the Railway Equipment Association, the Motor and Accessory Manufacturers Association, the Association of Ice Cream Supply Men, the recently formed Chemical Equipment Association and other groups representing the supply and equipment ends of leading industries, the members of which are manufacturers of miscellaneous commodities, but connected with a specific industry; for market expansion, educational work, publicity, research, credit protection and prevention of trade abuses is one of the most interesting current trade association trends.

The Chemical Equipment Association was organized Sept. 12, 1922, following preliminary activities of an organization committee of representatives of leading manufacturers.

The officers of the association are: President, Pierce D. Schenck, president of the Duriron Co., Inc., Dayton, Ohio; vice-presidents, J. George Lehman, vice-president and general manager of the Bethlehem Foundry & Machine Co., Bethlehem, Pa.; Walter E. Lummus, president, the Walter E. Lummus Co., Boston, Mass.; Adolph Coors, Jr., vice-president, Coors Porcelain Co., Golden, Colo.; treasurer, Percy C. Kingsbury, chief engineer, General Ceramics Co., New York City; secretary, Robert Everett.

The directors are: H. N. Spicer, the Dorr Co., New York City; P. S. Barnes, the Pfaudler Co., New York City; Edwin C. Alford, T. Shriver & Co., Harrison, N. J.; T. C. Oliver, Chemical Construction Co., New York City; Hamilton Allport, E. B. Badger & Sons Co., New York City.

The association has already established communication with nearly two hundred of the large industrial associations of the country, announcing itself as a source of information in chemical equipment supply matters, and has begun a regular bulletin service.

New York Section, A.C.S., Elects Officers

The separation of isotopes and their properties was the subject of a talk by James Kendall of Columbia University before the New York section of the American Chemical Society at Rumford Hall, Dec. 8. The subject was very timely in view of the recent selection of Frederick Aston as recipient of the Nobel prize in chemistry, in recognition of his work on this subject.

At the short business meeting which preceded Professor Kendall's talk, officers for 1923 were elected as follows: Chairman, Dr. C. A. Browne, N. Y. Sugar Trade Laboratory; vice-chairman, C. E. Davis, National Biscuit Co.; secretary-treasurer, Benjamin T. Brooks, Mathieson Alkali Works.

Executive Committee: M. H. Ittner, chief chemist, Colgate & Co.; James Kendall, Columbia University; H. C. Parmelee, editor, *Chem. & Met.*, and H. G. Sidebottom, Jayne & Sidebottom, Inc.

Councilors: C. A. Brown, C. E. Davis, Benjamin T. Brooks, James Kendall, H. C. Parmelee, H. G. Sidebottom, R. G. Wright, F. H. Getman, Ellwood Hendrick, K. G. McKenzie, David Wesson, H. R. Moody, M. H. Ittner, A. C. Langmuir, D. W. Jayne, B. R. Tunison, A. W. Thomas, Williams Haynes, Lois M. Woodford, Mary E. Pennington and F. M. Turner.

Chemical Exports Steady

Three Million Total for Month — Increase in Fertilizer Business

Exports of chemicals and allied products during October were valued at $8,159,044, according to returns to the Bureau of Foreign and Domestic Commerce. This figure indicates the continuance of exports in practically the same volume as in September and in October of 1921.

During October there was a slight increase in the value of the exports of chemicals proper, as compared with September. The value of chemicals, apart from allied products, exported in October is given as $3,811,342. There was a decided increase in the volume of fertilizers and fertilizer materials exported, but the value of those exports was less in October than in September. Fertilizers to the extent of 69,509 tons were exported during October, as compared with 55,518 tons in September. Exports of sulphate of ammonia decreased from 9,332 tons in September to 6,436 tons in October. Practically all of the October exports of this material went to Japan. Explosives exports in October aggregated 1,233,772 lb., a slight decrease as compared with the September forwardings.

Among the more significant items making up the October export figures are the following:

Benzol (lb.)	2,917,749
Sulphuric acid (lb.)	482,036
Boracic acid (lb.)	120,983
Wood and denatured alcohol (gal.)	124,718
Acetate of lime (lb.)	1,768,630
Calcium carbide (lb.)	720,272
Borax (lb.)	913,726
Caustic soda (lb.)	8,605,123

American Petroleum Institute Meets

Third Annual Convention, in St. Louis, Attracts Good Attendance

The American Petroleum Institute held its third annual meeting in St. Louis, Dec. 6 and 7. Addresses by men of national prominence in the petroleum industry attracted a large attendance at the various meetings of the Institute.

Two topics of vital importance to the industry were brought to the attention of those attending the meeting: first, the methods of producing, to the best possible advantage, commercial gasoline, and second, the standardization of oil-drilling methods and equipment. The latter movement has been launched in order to make it possible to secure repairs and new equipment by reducing the number of varieties of equipment manufactured.

Thomas A. O'Donnell, of Los Angeles, president of the association, assailed centralized government and federal control of industries at the opening general meeting. He said:

"I do not believe in bureaucracy in government. I believe it is destructive and not in the public interest. I believe everybody in the petroleum industry must recognize the danger confronting not only that industry but other lines of effort. The most destructive thing conceivable is an active government interference in business."

Addresses were delivered by Ivy L. Lee, W. S. Farish, of Houston, Tex., president of the Humble Oil & Refining Co.; P. E. Kistler, of Chicago, Ill., president of the Producers & Refiners Corporation, and James J. McGraw, of Tulsa, Okla., vice-president of the Exchange National Bank of Tulsa.

Directors Elected

The following directors were elected:

Pacific Coast Group—P. H. Hillman, Standard Oil Co. of California; K. R. Kingsbury, Standard Oil of California; H. R. Gallagher, Shell Co. of California.

Central United States Group—W. S. Farish, Humble Oil & Refining Co.; Robert W. Stewart, Standard Oil Co. of Indiana; P. C. Crenshaw, Home Oil Co.

Eastern United States Group—George W. Crawford, Ohio Fuel Supply Co.; A. C. Woodman, Union Petroleum Co.; R. D. Benson, Tidewater Oil Co.; Edward Prizer, Vacuum Oil Co.

Ships—J. Howard Pew, Sun Co.

Pipe Lines—J. H. O'Neil, Prairie Pipe Line Co.; A. A. Moody, Jarecki Manufacturing Co.

Europe—W. C. Teagle, Standard Oil of New Jersey.

To fill the unexpired term of office of Judge Martin Carey, deceased, H. L. Pratt, Standard Oil Co. of New York, to represent the Far East section of the foreign trade group.

The principal speakers at the annual banquet, Thursday evening, were Amos L. Beaty, of the Texas Co., and Sir Auckland Geddes, ambassador to the United States from Great Britain.

Appropriations Announced for Government Bureaus

Technical Departments Assigned Budgets to Continue Present Lines of Investigation

Appropriations totaling $1,339,031 for the Bureau of Chemistry in the Department of Agriculture have been approved by the Director of the Budget. The principal items making up this total follow: For carrying into effect the provisions of the food and drug act, $704,401; for salaries and wages, $308,970; for conducting investigations, relating to the application of chemistry to agriculture, $97,900; for collaboration with other departments desiring chemical assistance, $14,000; for the investigation of problems connected with the manufacture of sugar and sirup, $35,000; to carry into effect the provisions of the act with regard to the prevention of imports of impure tea, $38,000; naval stores investigation, $10,000; insecticides investigation, $20,000; for investigations looking to the prevention of grain dust explosions, $25,000; for the investigation and development of methods of utilizing wool-scouring waste, $9,000.

PERSONNEL

The budget for the next fiscal year provides for the employment of 219 chemists in the bureau. There are in addition a considerable number of employees with chemical training who are classified under other titles.

The budget calls for an appropriation of $310,775 for the Bureau of Soils. The principal items making up that total are: Salaries, $76,440; for chemical investigations of soil composition and soil minerals, $23,110; for physical investigations of important properties of soil, $12,225; for investigations of fertilizers, $60,000; for soil surveys, $120,000.

BUREAU OF STANDARDS

Total appropriations of $1,742,360 were approved for the Bureau of Standards. The principal items making up that total are as follows: Salaries, $432,360; for apparatus, machinery and other appliances, $75,000; for testing structural materials, $195,000; for maintenance and operation of testing machines, $35,000; for investigation of fire-resisting properties of building materials, $25,000; for investigation of the standards of practice and methods of measurements of public utilities, $95,000; for testing miscellaneous materials, including chemicals, varnishes and inks, $40,000; for the investigation and standardization of methods and instruments employed in radio communication, $40,000; to develop color standards, $10,000; to study technical processes used in the manufacture of clay products, $30,000; to develop methods of standardizing mechanical appliances, $40,000; for the investigation of the problems involved in the production of optical glass, $20,000; to investigate textiles, paper, leather and rubber, to develop standards of quality, $25,000; for the standardization and design of sugar testing apparatus and the development of technical specifications for the various grades of sugar, $40,000; for the standardization and testing of standard gages and screw-threads, $40,000; for investigating mine scales, $15,000; for metallurgical research, $50,000; for investigations of high-temperature measurements and control, $10,000; for the investigation of the principles of sound, $5,000; for industrial research, $190,000; for testing large scales, $40,000; for investigations in the establishment of standards for instruments, tools, electrical and mechanical devices, $100,000; for the purchase, preparation and analysis of standard materials, to be used in checking chemical analyses, $10,000; for the investigation of radioactive substances, $10,000; for the maintenance and equipment of automotive engine test plants, $40,000; for determining fundamental data, $20,000.

Coal-Tar Tariff Provisions Discussed

Department of Commerce Will Compile Monthly Statistics on Imports of Dyes and Chemicals

Applications of the provisions of the new tariff law to imports of coal-tar products were discussed with the customs service by dye importers at meetings last week. Particular interest was evidenced in the attitude to be taken by the customs service in determining whether similar competitive articles are produced in the United States for the purpose of imposing the ad valorem rate based on the United States value.

Work on the rules to govern the imposition of tariff rates on coal-tar products, it was said, is going forward steadily, but progress is necessarily slow because of the scope of the investigations to determine United States value and the substantial results accomplished by imported coal-tar products as compared with domestic products.

TO COMPILE MONTHLY STATISTICS

Statistics giving itemized imports of coal-tar dyes and chemicals will be published monthly by the Department of Commerce, through co-operation of the Customs Division of the Treasury Department and the Tariff Commission. Plans are being made to issue the first report in January, if arrangements can be completed in time.

The data will be gathered from customs invoices at New York, the principal port of such entries, by a clerk assigned to this duty by the Tariff Commission, and sent to the commission's headquarters in Washington, where they will be compiled by experts of the chemical division, and sent to the Commerce Department for publication. Colors, strength and, wherever possible, prices will be included in the reports.

It is expected that the monthly reports will be available for publication 2 weeks after the close of each period.

Will Survey White Arsenic Situation

De Long Arranges Conference With Producers, Independent of Investigation Demands of Legislators

The production of a larger supply of calcium arsenate, with which to check the ravages of the cotton boll weevil next season, is the purpose of a conference of manufacturers of white arsenic and calcium arsenate and officials of the departments of Agriculture, Interior and Commerce, to be held at the Hotel Astor, New York, Dec. 13.

The conference was arranged by C. R. De Long, formerly chief of the chemical division of the Department of Commerce and now head of the dye and chemical section of the Tariff Commission. Mr. De Long, who will preside at the meeting, explains that the object will be to find out just how much white arsenic is available for the manufacture of calcium arsenate, the principal boll weevil insecticide.

The Department of Justice will assign an agent to investigate whether there exists an unlawful combination to control the supply and price of white arsenic, according to a letter received by Senator Harris of Georgia from the department. Investigation was asked by Senator Harris after complaints from constituents that the price of calcium arsenate had doubled within a year and that the supply was short.

The Department of Justice also proposes to conduct another investigation into the fertilizer situation, following complaints from some sections that prices are uniform, according to another letter from the department. A fertilizer investigation by agents of the department last spring failed to disclose any combination.

SCARCITY DUE TO SMELTERS' INACTIVITY

The high price of the arsenate, which has resulted in Congressional action, is caused, Mr. De Long states, by the shortage of white arsenic. This, he said, is a result of inactivity in the lead and copper smelting industry. The enormously increased demand for the insect poison, together with the decreased supply, has resulted in the present acute shortage, which promises to become more serious unless steps are taken to increase the output. It is hoped, as a result of the meeting, to uncover stocks of arsenic, and make them available for insecticide manufacture and to encourage a new undeveloped output.

Senator Smith of South Carolina introduced a resolution, which has since been adopted, directing the departments of Agriculture and Interior to make an investigation of this industry and report to the Senate the cause of the prevalent high price. It especially directs an investigation of the charges that this product is in the hands of a monopoly. Mr. De Long declares that plans for this conference were made prior to the introduction of the Senate resolution.

Bureau of Mines Report

(Continued from page 1189)

drained, and offset wells have been drilled with remarkable speed.

Other Mineral Reserves

The United States Government is one of the largest coal-land owners in the world and also holds important reserves of phosphate, potash and other salts. Although just at present, because of the prior development of mines and industries in the Eastern states, coal mining on the public domain is overshadowed by private industry, in the years ahead the leased mines may well become the more important. Every effort is accordingly being made to establish the new system on a correct basis, properly to protect the public interest in safe and efficient mining, and not unduly to hamper private initiative in operation. Coal is now being mined under lease in Washington, Montana, North Dakota, South Dakota, Wyoming, Utah, Colorado, New Mexico and Nevada. Phosphate rock is being mined in Idaho, and coal and other mines on Indian lands are being supervised in still other states. On the public lands proper the Bureau of Mines is now charged with supervision of 29 coal leases, 200 coal-prospecting permits, 5 coal licenses, 1 phosphate lease, 1 oil-sand lease, 1 potash lease and several potash prospecting permits. In all, nearly 240,000 acres scattered through 10 states require supervision, and the average is rapidly increasing. The work is directed through a mining supervisor with headquarters at Denver, Colo.

Safety and Rescue Work

In addition to the technical supervision of mineral production on public lands, the Bureau of Mines engaged in numerous other activities associated with problems of safety and efficiency in the various mineral industries. During the year, 16,291 persons were trained in first-aid and rescue work, thus constituting a considerable addition to the legion of skilled men and women who stand ready to render valuable humanitarian aid to those subjected to peril in times of mine disasters. Studies of health hazards in the petroleum industry were made by the bureau in co-operation with the Public Health Service and the American Petroleum Institute. Smoke abatement surveys were made at Salt Lake City, Buffalo, N. Y., and Grafton, W. Va. A fuel-economy survey of the government heat and power plants in the District of Columbia was undertaken. New plans were justified and set for impurity allowances in the Salt Creek, Wyo., oil field which will increase government revenue $40,000 per annum on present production. The value of waste coal in dumps at Wilkeson, Wash., was demonstrated, with the result that a plant for the recovery of 150,000 tons is now being erected. The difficulty in the way of using low-priced cyanide in metallurgical work was discovered and remedied, resulting in the breaking of a monopoly in this important chemical material.

Fries Commends C.W.S.

(Continued from page 1189)

troops on the field of battle, for screening naval squadrons at sea in attack or defense, is a field which requires the study of every student of tactics or strategy. Screening smoke materials are applicable to use in every character of projectile, whether dropped from airplanes, fired from guns or thrown by hand. They are used to form the screen for attack, and the screen for defense. The ability to use this screen close to or at a considerable distance from moving troops increases enormously the difficulty of knowing where to aim artillery and other long range guns. Research and development in this line are in their infancy, while the study of the tactical use of smoke has scarcely begun.

"Purely incendiary materials are generally of much less importance. They have their fields of usefulness in attacking military stores, ordnance depots and the like. On the other hand, a smoke-producing material as white phosphorus, which is also capable of creating casualties by burning, has a very considerable importance in attack or defense. White phosphorus is adaptable to use by every arm of the service and every projectile, not only as a smoke as stated above, but as a burning material to attack personnel. While few deaths will result, many will be put out of action, while the moral effect of burning phosphorus is too great to be overlooked at any time.

"Consideration of the possibilities in the field of chemical research will give an understanding of the advisability of continuing the work into the toxicological properties and characteristics of chemical compounds, which information this country must have to even approximate chemical preparedness. It is work that cannot be done properly along scientific lines in any other place than in such an institution as exists in Edgewood Arsenal. In addition, indications are sufficiently clear to show the possibilities of using many of the results obtained in this work to the advantage of the country in peace time. An analysis of the importance of this work in connection with the funds required to carry it on shows clearly a full justification.

Recommendations for Future

"For the healthy and reasonable continuance of the activities at Edgewood Arsenal in future, the following recommendations are made:

Establish a continuity of policy as regards the character and scope of research and development. An absolute minimum of $2,000,000 should be devoted to this work annually.

Increase the activities of the Chemical Warfare School to include the training of selected officers and non-commissioned officers of the line.

Maintain present large-scale plants in an operating condition. This can be done and provide for minor improvements at a cost not to exceed $150,000 per year.

Manufacture a limited number of gas masks and other protective devices annually. A minimum expenditure for this purpose would be $500,000.

Provide for the manufacture of training supplies and munitions at an estimated minimum cost of $200,000 per annum.

Provide for the upkeep and operation of utilities and the preservation of supplies and munitions in storage. This is an expenditure of approximately $400,000 per year.

Revoke the decision to turn over a section of the arsenal and a part of its facilities as an artillery station. All space and facilities are required for the normal peace time operation of the activities concentrated at Edgewood Arsenal and at the same time provide for a reasonable expansion in case of an emergency.

"The past year has seen the establishment of a sound and reciprocal basis of relations between the Chemical Warfare Service and other branches of the War and Navy Departments, and also other departments of the government. Chemical warfare can aid these departments greatly in peace. The store of knowledge in the C.W.S. of poisonous compounds has been shown to be of the greatest value to almost every branch of the government."

Personal

George W. Heintz, for a number of years vice-president and general manager of the United States Smelting, Refining & Mining Co.'s metal operations in Utah, Colorado, Nevada, Arizona and California, with headquarters at Salt Lake City, and for the past 3 years a vice-president in charge of Western operations of the same company in Boston, has resigned, effective Jan. 1, 1923. Simultaneously Mr. Heintz relinquishes the executive office of the Sunnyside Mining & Milling Co., the Bullion Beck Mining Co., the Niagara Mining Co. and the United States Stores Co., all of which are subsidiary or affiliated companies of the United States Smelting, Refining & Mining Co. After a short vacation Mr. Heintz will engage in consulting work in Boston.

Chester A. Hammill, geologist, gave an interesting address on recent developments in the oil and gas fields of Texas, at a recent meeting of the Technical Club, Dallas, Tex.

Hugh M. Henton, who is now assistant professor of mining and metallurgy in the Washington State College of Washington, Pullman, Wash., has not been connected with the Aluminum Castings Co., as mentioned in the personal in our issue for Nov. 15.

Dr. Horace C. Porter, consulting chemical engineer on fuels, Philadelphia, Pa., spoke before the Syracuse Section of the American Chemical Society, Dec. 8, on "Coal Carbonization and the World's Fuels."

Marcus A. Grossmann has been appointed metallurgist of the Atlas Steel Corporation, a consolidation of the Electric Alloy Steel Co. and the Atlas Crucible Steel Co. His new headquarters are in Dunkirk, N. Y.

G. A. Swain, assistant to the manager of the supply department of the Westinghouse Electric & Manufacturing Co., has been elected chairman of the committee on instruments and measurements of the American Institute of Electrical Engineers.

Market Conditions

In Chemical, Metallurgical and Allied Industries

A Survey of the Economic and Commercial Factors That Influence Trade in Chemicals and Related Commodities
Prevailing Prices and Market Letters From Principal Industrial Centers

New Records of Industrial Activity

Production and Distribution Movements of Basic Commodities Show Striking Increases, Thus Confirming Other Evidence of Business Expansion

OCTOBER set records for even greater industrial activity than in any month of the current year. The output of almost all basic commodities showed large increases, sometimes even when the usual seasonal declines were expected. Among others, the following products were produced in larger volume than in any month since 1920: pig iron, steel ingots, byproduct coke, copper, zinc, wood chemicals, cement, brick and crude petroleum. Consumption of cotton, wool and newsprint paper were at new high levels.

Corresponding increases are shown in the activity of all distributive movements, such as wholesale and retail trade, car loadings, bank clearings, magazine and newspaper advertising, postal receipts and the greater demands for money.

TABLE I—MONTHLY PRODUCTION OF BASIC COMMODITIES IN TERMS OF AN ESTIMATED NORMAL

(Estimated normal production = 100 per cent)

Commodity	May	June	July	Aug.	Sept.	Oct.
Anth. coal	0.4	1.0	1.4	1.9	61	94†
Bit. coal	41	43	32	46	72	75†
Pig iron	73	79	82	61	68	83
Steel ingots	81	82	79	70	74	85
Copper	70	75	75	86	80	84†
Tin, delivered	92	90	75	77	92	103
Zinc*	51	53	60	59	62	75
Petroleum	111	110	110	112	111	112†
Cement	119	120	128	121	123	126
Sugar meltings	146	135	131	144	110	108
Cotton consumed	88	92	84	97	92	95
Wood pulp	108	110	105	105	102	....
Paper (total)	100	100	93	107	105	....
Gasoline	96	101	109	103	104	....
Wool consumed*‡	116	116	103	126	121	131

* Seasonal variation not allowed for. † Preliminary. ‡ Estimated.

"Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

This week	161.72
Last week	160.60
December, 1921	145
December, 1920	245
April, 1918 (high)	286
April, 1921 (low)	140

The chemical market continued to show the strength that has been evident for the past few weeks. The prices of all of the commodities represented by this index were maintained at the higher levels previously reported. Increases were recorded for glycerine and cottonseed oil.

Textiles Active

The textile industries, which are probably the most important consumers of chemical products, reported figures to the Department of Commerce showing the largest consumption of cotton and silk for any month in over 2 years. There was also a pronounced increase in the consumption of wool by textile mills in October. The total of 59,282,000 lb. is the largest since 1920, with the exception of March of this year, when 60,368,000 lb. was consumed. Consumption in the first 10 months of this year is about 25 per cent greater than in the corresponding months of last year. Woolen and worsted machinery showed further increases in activity in October. This was particularly marked in spindles and in wide and narrow looms, while combs, due to overtime work, showed 106.4 per cent of hours active in October. Cotton machinery activity also increased. Exports of cotton cloth declined slightly in October, with a total of 50,985,000 sq.yd. Consumption of cotton fabric by tire manufacturers increased.

Metals

Production of pig iron during October totaled 2,638,000 tons, the largest output since December, 1920. Daily blast-furnace capacity in operation increased from 77,005 tons at the outset of the month to 87,935 at the close. Steel ingot production was 3,283,000 tons, as compared with 2,713,000 tons during September, an increase of 21 per cent. Unfilled orders for finished products on the books of the United States Steel Corporation Oct. 31 amounted to 6,902,000 tons, as compared with 6,692,000 tons Sept. 30, an increase of 3 per cent.

The production of both copper and zinc showed large increases in October and in each case exceeds the output for any month in more than 2 years. Stocks of zinc again declined, reaching the lowest figure since 1919.

The petroleum industry established several new records in October. Pro-

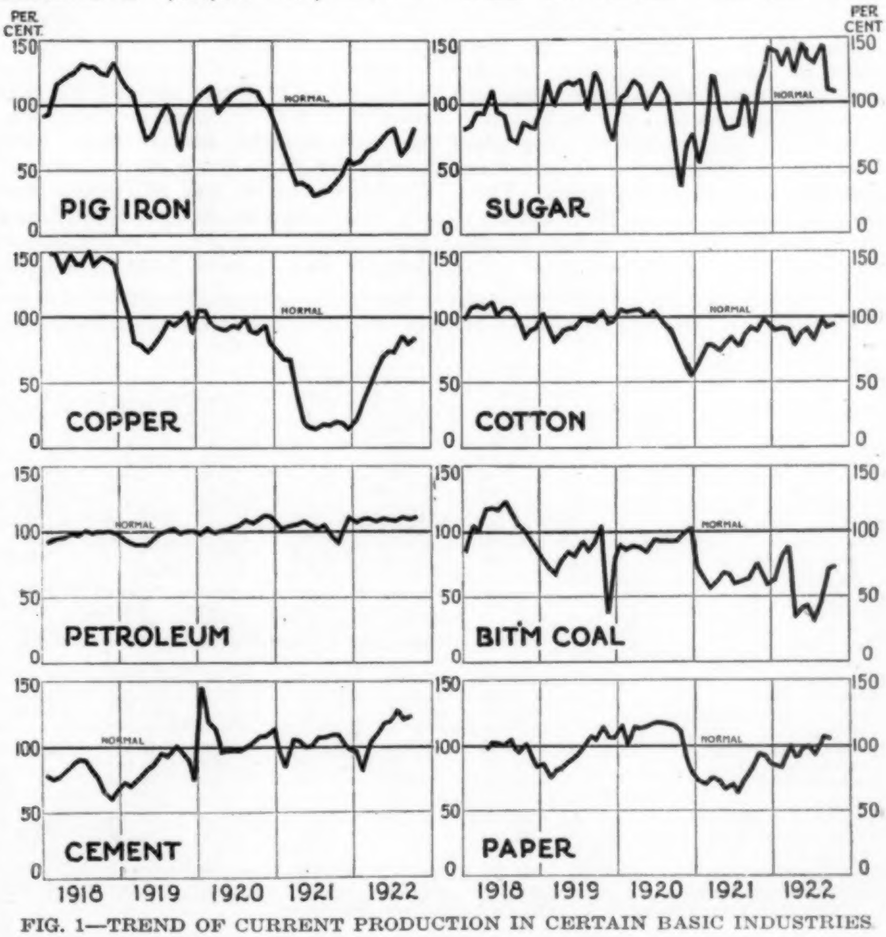


FIG. 1—TREND OF CURRENT PRODUCTION IN CERTAIN BASIC INDUSTRIES

duction at 47,255,000 bbl. of crude is the largest ever reported for one month. Consumption jumped to 52,269,000 bbl., compared with the previous maximum of 50,141,000 bbl. reported for August this year. Stocks again increased to a new high level of 274,438,000 bbl.

Paper and Rubber

Newsprint production also increased in October, with a total of 130,682 tons, or over 5,000 tons more than in September, and, with the exception of August, is the largest for any month since 1920. Newsprint consumption by publishers for October increased to 192,431 tons, or 20,000 tons more than in September, and the largest for any month since these reports were started. Stocks of newsprint, particularly those in the hands of publishers, declined.

Rubber consumption by tire manufacturers increased in October, compared with September, and was about 60 per cent greater than in October a year ago. There was a corresponding increase in the production of tires and tubes. Shipments of tires and tubes showed little change from September, while stocks increased slightly, although still considerably below those reported a few months ago.

Production Trends

Included with this article are two tables of interest as showing the general trend of production in the basic industries. Table I, a compilation of the Federal Reserve Bank of New York, shows production for the past 6 months expressed as percentages of an estimated normal production. In these estimates allowance has been made for year-to-year growth and for seasonal variations. These data are presented graphically in Fig. 1.

Table II is a tabulation of production figures for a number of important chemical and allied industries. These data are taken from "The Trend of Business Movements" section of the *Survey of Current Business*.

Better Demand and Firmer Prices in Chicago

Numerous Advances Reported Principally for Wood-Distillation Products and Heavy Chemicals

Chicago, Dec. 8, 1922.

Although little change was apparent in the general condition of the heavy chemical market during the week ended Dec. 7, prices as a whole were very firm and quite a few advances were reported. All wood products were in an exceptionally firm position and still higher prices were predicted in some quarters.

Alkalis Show Better Movement

Caustic soda continued firm, with a good inquiry reported by the dealers. Spot 76 per cent material was quoted in ton lots at $3.50 per 100 lb. for the solid and $4.25 for the ground or flake. *Caustic potash* was in fair demand and imported material testing 88-92 per cent was available at 7¼@7½c. per lb. *Soda ash* moved in a good volume, with $2.25 per 100 lb. the prevailing quotation quotation for 58 per cent material in cooperage.

Alums were in fair demand with the supply light. *Potash alum* was offered in small lots at 4½@5c. per lb. for the lump and 5½@6c. for the powder. *Aluminum sulphate* was scarce and the ground iron-free was very firm at 2½@3c. per lb. *Sal ammoniac* enjoyed a fair demand and the white granular was quoted at 7½@8c., per lb. in small or moderate lots. *Ammonium carbonate* was scarce on spot and the lump was held at 11@12c. per lb. Barium compounds continued firm and were unchanged in price. *Barium chloride* was available at $110 per ton and the carbonate at $90. *Copper sulphate* was in fair demand and crystals were quoted by first hands at 6c. per lb. *Carbon bisulphide* was still scarce and the small supplies on spot were firmly held at 7½c. per lb. *Carbon tetrachloride* was in good demand and the price was advanced to 10½c. per lb. for the large drums. *Furfural* was reported to be moving in a fair way and the price was unchanged at 25c. per lb. for 1,000-lb. lots. *Formaldehyde* was again advanced, the new level being 16c. per lb. in barrels for less than 5-bbl. lots. *Glycerine* was reported to be in a somewhat firmer position and the price of 18½c. per lb. for c.p. material in drums was maintained. *Magnesium metal* was in poor demand and the *powder* was offered in 100-lb. lots at $1.15 per lb.

Linseed Oil and Turpentine Sluggish

Bichromates were unchanged in price and were reported to be moving in a fair way. The *soda bichromate* was quoted at 9@9½ c. per lb. and the *potash* at 12@13c. *Potassium cyanide* was slightly lower due to fresh arrivals and single-case lots were available at 53c. per lb. *Potassium ferrocyanide* was very firm with only small lots available at 42@43c. per lb. *Potassium ferricyanide* was still very scarce, with only an odd lot here and there available at 95c@$1 per lb. *Permanganate of potash* was in fair request and supplies of the imported U.S.P. crystals were quoted at 18@19c. per lb. *Chlorate of potash* was firm with small lots of the powdered offered at 9c. per lb. *Sodium acetate* was in good demand and very scarce with only a few small lots available at 9@9½c. per lb.

Very little demand existed for *linseed oil*, with nearly all factors reporting the market extremely quiet. The boiled oil was quoted today at 90c. per gal. in single-drum lots and the raw at 88c.

Turpentine was in a position similar to that of linseed oil and very little was moved to the dealers. The consuming trade looks for lower prices and shows little or no interest in the present market. Today's price for single-drum lots was $1.46 per gal. delivered to the buyer's plant.

TABLE II—THE TREND OF CURRENT PRODUCTION IN CERTAIN CHEMICAL, METALLURGICAL AND ALLIED INDUSTRIES

Production of—	Feb., 1922	March, 1922	April, 1922	May 1922	June, 1922	July, 1922	Aug., 1922	Sept., 1922	Cumulative Total Through Latest Month 1921	Cumulative Total Through Latest Month 1922	Per Cent Increase or Decrease 1922 from 1921
Acetate of lime, thous. of lb.	7,942	11,134	7,836	7,107	....	....	8,532	....	33,126	65,182	+96.7
Alcohol (wood), gal.	433,024	587,928	418,271	380,237	....	....	480,200	....	2,223,669	3,678,970	+65.4
Cement, thous. of bbl.	4,278	6,685	9,243	11,176	11,245	11,557	11,664	11,424	72,307	81,563	+12.8
Coke, byproduct, thous. of short tons	1,795	2,137	2,227	2,537	2,580	2,486	1,794	2,244	14,558	19,703	+35.3
Coke, beehive, thous. of short tons	549	732	528	432	458	450	539	606	4,246	4,790	+12.8
Cottonseed oil, thous. of lb.	91,321	72,237	27,610	12,389	19,431	13,380	13,354	98,609	796,089	429,166	—46.1
Leather, sole, thous. of sides	1,466	1,473	1,327	1,321	1,359	1,353	1,509	1,491	12,771	12,991	+1.8
Leather, finished upper, thous. of sq.ft.	70,296	77,510	66,700	67,275	65,570	62,807	76,067	73,170	486,407	633,958	+30.3
Linseed oil*, thous. of lb.	6,647	7,232	6,069	7,952	8,271	5,795	5,536	11,237	75,790	65,196	—14.0
Metals:											
Pig iron, thous. of long tons	1,630	2,035	2,072	2,307	2,361	2,400	1,816	2,034	12,232	18,299	+49.6
Steel ingots, thous. of long tons	2,072	2,816	2,794	3,099	3,012	2,843	2,532	2,714	13,858	23,591	+69.7
Copper, thous. of lb.	37,416	61,867	76,601	88,714	95,633	91,317	100,838	95,665	406,471	677,367	+66.6
Zinc. thous. of lb.	45,026	53,064	51,012	54,838	57,094	63,834	62,846	66,268	315,856	501,394	+58.7
Paper and pulp:											
Wood pulp, chemical, sh. tons	144,568	170,995	147,608	167,197	164,931	154,617	172,700	170,329	1,607,095	1,450,242	+35.9
Newsprint, sh. tons	97,786	117,507	111,861	129,950	127,230	120,839	133,236	125,402	910,870	1,069,619	+17.4
All grades paper, short tons	404,031	475,353	528,461	589,971	593,335	552,914	635,107	623,088	3,769,749	5,124,748	+35.9
Petroleum:											
Crude oil, thous. of bbl.	40,814	46,916	44,635	46,473	45,559	46,593	46,521	45,246	354,263	405,616	+14.5
Gasoline, thous. of gal.	398,223	472,228	472,920	513,659	525,941	....	549,958	....	3,424,761	3,947,313	+15.3
Kerosene, thous. of gal.	167,220	178,785	188,809	173,824	173,650	....	184,383	....	1,263,100	1,432,512	+13.4
Rubber:											
Crude†, thous. of lb.	18,467	26,771	43,407	35,727	39,655	28,181	33,739	28,051	159,804	249,238	+56.0
Pneumatic tires, thous.	2,084	2,646	2,401	2,722	2,839	2,497	2,905	2,505	16,295	22,633	+38.9
Sugar:											
Imports, raw, lon tons	448,321	571,836	473,137	446,678	460,480	451,011	425,960	174,232	2,206,169	3,766,584	+70.7
Meltings, raw, long tons	415,723	535,357	531,962	577,330	532,052	530,334	540,024	312,909	2,798,365	4,267,292	+52.5

* Shipments from Minneapolis. † Consumption by tire manufacturers.

Stronger Market for Steel Products

Slight Declines, However, Shown for Pig Iron and Coke

PITTSBURGH, Dec. 8, 1922.

While there has been expectation in recent weeks in many quarters that steel prices would decline shortly, the expectation should have been confined to bars, shapes and plates, for other finished steel products are in a particularly strong position. Even in the lines mentioned, however, there is no particular weakness seen to be developing. The argument that actual ultimate consumption is hardly equal to the present rate of shipping by steel mills is more easily defended than would be a claim that all the steel now being shipped is passing promptly into consumption.

SHEET BARS TO BE HIGHER

In the actual steel market, the important event in a week of few definite developments was the announcement of the Carnegie Steel Co. of its first-quarter price on sheet bars, at $36.50, or somewhat above the average expectation, since the trade at large had scarcely thought the price would be above $35. The price applies to sheet bars supplied the subsidiary in the Steel Corporation, the American Sheet & Tin Plate Co., and to certain independent mills with which there are long-term contracts under which the Carnegie Steel Co. obligates itself to furnish sheet bars at a price to be named quarterly, the buyer having the privilege of refusing to take the steel in any particular quarter if the price is not considered satisfactory. The Carnegie Steel Co. does not sell sheet bars in the open market. Its price is, however, usually a lead to the independents who sell bars. On Nov. 23, on opening its order books for deliveries after Jan. 1, the American Sheet & Tin Plate Co. reaffirmed its former prices, $4.75 for tin plate, 2.50c. for blue annealed sheets, 3.35c. for black sheets, 4.35c. for galvanized sheets and 4.70c. for automobile sheets. The prospect is further reduced that these prices will be cut. As to automobile sheets, the independents had a 5c. price and are adhering to this figure, which they will probably be able to obtain in sales for first quarter, as the leading interest is filled for first quarter, its present sales being substantially for second quarter.

Bars, shapes and plates continue quotable at a general price of 2c., there being some concessions, as formerly in the case of particularly desirable orders.

Pipe mills have not caught up on deliveries and remain under considerable pressure, particularly in the case of butt weld sizes of merchant pipe, the best delivery on which is eight weeks, in the case of new orders. Wire mills are also under some pressure, particularly in nails.

Connellsville furnace coke for spot shipment is off 50c. in the week, at $6.75@$7. For delivery over the remainder of the year $7 or $7.25 can be done, and one sale at $6.75 is reported.

Valley pig iron has continued to decline in price, as it has been doing for 2 months or more. The week's additional decline is a small item, while the development of some demand, with perhaps two or three fair-sized purchases actually made for first quarter, is a strictly new development. The market now has two sides, even if the new side is thus far but a weak one. The market as quotable is down 50c. on bessemer to $28, 50c. on basic to $25 and $1 on foundry to $25.50, with single carloads generally going at $26, all prices being at valley furnaces, with $1.77 freight to Pittsburgh.

Arsenic Still the Feature of the New York Market

Consuming Interests Are Showing Concern Regarding Present High Prices and Possible Shortage

The manufacturers of insecticides and representatives of the consuming industries are vitally concerned with developments in the arsenic market. It is becoming more and more evident that the successful prosecution of the campaigns now proposed for combating the boll weevil depends primarily on the possibilities of a greatly increased supply of white arsenic. The recent inactivity of the lead and copper smelting industries and the smaller imports from Japan are the principal causes of the current shortage and consequent high prices. Among dealers and second hands the price range has reached 15 to 15½c. per lb., although producers' prices are somewhat under this.

NUMEROUS PRICE CHANGES

Formaldehyde prices were advanced ¾c. per lb., due to the recent increase in methanol quotations. Material at the works is quite scarce and some producers reported a heavily sold-up condition. Manufacturers of iodides announced an increase of 10c. per lb. on all varieties. Producers of oxalic acid have been forced to meet foreign competition and quoted lower prices at the works and for spot material. Prussiates showed a slight tendency to weaken during the interval in the absence of any noticeable activity. The alkali market for domestic consumption was strongly maintained and the volume of contracts for 1923 was quite satisfactory to producers. Bleaching powder was reported very firm at the works. Denatured alcohol was again advanced 2c. per gal.

GENERAL AND SPECIAL CHEMICALS

Arsenic.—The spot market is very strong and supplies are light. Producers report a sold-up condition at the works. The resale range is around 15@15½c. per lb., with domestic producers quoting 12¾c. per lb.

Barium Chloride—Consumers have shown little desire to purchase any round lots and importers are inclined to shade the market. Spot prices are quoted at $90@$95 per ton.

Bichromate of Potash—Producers quote the market around 9¾@10c. per lb. for spot and future shipments. Consumers have shown some desire for 1923 contracts.

Carbonate of Potash—Calcined 80-85 per cent was reported fairly steady at 6c. per lb. Hydrated 80-85 per cent has been quite scarce with holders asking around 7¼c. per lb. for limited quantities.

Caustic Potash—Imported 88-92 per cent material was quoted at 6½c. per lb. Importers offer shipments at 6¼c. per lb., duty paid. Activity was limited to small lot trading.

Caustic Soda—The export market showed very little change and prices remained at $3.50@$3.60 per 100 lb., f.a.s. New York. Domestic business continued along very active lines at 3¾@4c. per lb. ex-store. Producers quote contracts at $2.50 per 100 lb., basis 60 per cent. f.o.b. works in carload lots. A good inquiry was reported.

Formaldehyde—Prices were again increased to 14¼c. per lb. in carload quantities and 14¾c. in less than carlots. Business among resale dealers was somewhat quiet although a heavily sold-up condition at the works was reported. Second-hand lots were quoted at 13¾@14c. spot, ex-store.

Magnesium Sulphate—The market showed complete signs of improvement. Domestic, technical, was quoted at $1.85@$2 per 100 lb. in bags and $2.25 @$2.50 in barrels. Imported, technical, was held at $1.20@$1.30 per 100 lb.

Oxalic Acid—Domestic manufacturers have been forced to reduce prices to 13½c. per lb., f.o.b. works, due to the foreign competition. Imported goods are on the market at 13½c. per lb., ex-warehouse. Domestic goods on spot were held at 14@15c. per lb.

Prussiate of Soda—The spot market was somewhat weaker and sales were recorded for small lots down to 20c. per lb. The general range is 20@21c.

Soda Ash—There has been very little change reported in the export or domestic markets. Light ash, 58 per cent, bags on spot, was quoted at $1.75@$1.80 per 100 lb. Producers reported a very good contract call at $1.20 per 100 lb., basis 48 per cent, f.o.b. works.

VEGETABLE OILS

Linseed Oil—Immediate shipment oil was offered at 85c. per gal., carload basis. January supplies were available at 82c. and January-April at 78c. per gal. Future trading was dormant during the interval.

Coconut Oil—The general tone was rather quiet, but prices kept quite steady. Ceylon type oil at New York held at 8@8¼c. per lb., tank cars, with barrels around 8¾c. per lb.

Corn Oil—Offerings were somewhat limited and the spot market appeared nominal. Sellers were asking 8¾c. per lb., tank cars, for crude in nearby positions. Refined oil was well sustained at 11@11¼c. per lb. in barrels.

General Chemicals

Current Wholesale Prices in New York Market

		Carlots F.o.b. N. Y.	Less Carlots F.o.b. N. Y.
Acetic anhydride	lb.	-	$0.37 - $0.40
Acetone	lb.	$0.21 - $0.21½	.21½- .22
Acid, acetic, 28 per cent	100 lb.	3.50 - 3.60	3.65 - 4.00
Acetic, 56 per cent	100 lb.	7.00 - 7.15	7.20 - 7.50
Acetic, glacial, 99½ per cent, carboys	100 lb.	14.00 - 14.25	14.30 - 14.50
Boric, crystals	lb.	.11½- .11¾	.12 - .13
Boric, powder	lb.	.11 - .11½	.11½- .12½
Citric	lb.	-	.50 - .52
Hydrochloric, 18 deg	100 lb.	.90 - 1.00	1.05 - 1.20
Hydrochloric, 20 deg	100 lb.	1.00 - 1.10	1.20 - 1.40
Hydrofluoric, 52 per cent	lb.	.11 - .11½	.11½- .12
Lactic, 44 per cent tech	lb.	.11 - .11½	.11½- .12
Lactic, 22 per cent tech	lb.	.05 - .05½	.05½- .06
Muriatic, 20 deg. (see hydrochloric)		-	-
Nitric, 40 deg	lb.	.05½- .05¾	.06 - .06½
Nitric, 42 deg	lb.	.06 - .06¼	.06½- .07
Oxalic, crystals	lb.	.14 - .14¼	.14½- .15
Phosphoric, 50 per cent solution	lb.	.07½- .08	.08¼- .09
Picric	lb.	.20 - .22	.23 - .27
Pyrogallic, resublimed	lb.	-	1.55 - 1.65
Sulphuric, 60 deg., tank cars	ton	9.00 - 10.00	-
Sulphuric, 60 deg., drums	ton	12.00 - 14.00	-
Sulphuric, 66 deg., tank cars	ton	14.50 - 15.00	-
Sulphuric, 66 deg., drums	ton	19.00 - 20.00	20.50 - 21.00
Sulphuric, 66 deg., carboys	ton	-	-
Sulphuric, fuming, 20 per cent (oleum) tank cars	ton	19.00 - 20.00	-
Sulphuric, fuming, 20 per cent (oleum) drums	ton	22.00 - 22.50	23.00 - 24.00
Sulphuric, fuming, 20 per cent (oleum) carboys	ton	31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.	lb.	-	.70 - .75
Tannic (tech.)	lb.	.40 - .45	.46 - .50
Tartaric, imported crystals	lb.	-	.30½- .31
Tartaric acid, imported, powdered	lb.	-	.31 - .32
Tartaric acid, domestic	lb.	-	- .32
Tungstic, per lb. of WO	lb.	-	1.20 - 1.30
Alcohol, ethyl (Cologne spirit)	gal.	-	4.75 - 4.95
Alcohol, methyl (see methanol)		-	-
Alcohol, denatured, 188 proof No. 1	gal.	-	.39 - .41
Alcohol, denatured, 188 proof No. 5	gal.	-	.38 - .40
Alum, ammonia, lump	lb.	.03½- .03¾	.04 - .04¼
Alum, potash, lump	lb.	.03¼- .03½	.03¾- .04
Alum, chrome lump	lb.	.05 - .05¼	.05½- .06
Aluminum sulphate, commercial	100 lb.	1.50 - 1.65	1.70 - 2.25
Aluminum sulphate, iron free	lb.	.02½- .02¾	.03 - .03½
Aqua ammonia, 26 deg., drums(750 lb.)	lb.	.06¾- .07¼	.07½- .08
Ammonia, anhydrous, cyl.(100-150 lb.)	lb.	.30 - .30½	.30½- .31
Ammonium carbonate, powder	lb.	.09 - .09½	.09½- .10
Ammonium nitrate	lb.	.06 - .06½	.06¾- .07½
Amylacetate tech	gal.	-	2.35 - 2.60
Arsenic, white, powdered	lb.	.15 - .15¼	.15½- .15¾
Arsenic, red, powdered	lb.	.13½- .14	.14½- .15
Barium carbonate	ton	75.00 - 77.00	78.00 - 80.00
Barium chloride	ton	90.00 - 95.00	96.00 -100.00
Barium dioxide (peroxide)	lb.	.18 - .18½	.19 - .20
Barium nitrate		.08½- .08¾	.09 - .09½
Barium sulphate (precip.) (blanc fixe)	lb.	.04 - .04½	.04½- .04¾
Blanc fixe, dry	lb.	.04 - .04½	-
Blanc fixe, pulp	ton	45.00 - 55.00	-
Bleaching powder	100 lb.	2.25 - 2.35	2.40 - 3.50
Blue vitriol (see copper sulphate)		-	-
Borax	lb.	.05½- .05¾	.06 - .06¼
Brimstone (see sulphur, roll)		-	-
Bromine	lb.	.27 - .28	.28½- .35
Calcium acetate	100 lb.	3.50 - 3.60	3.65 - 3.75
Calcium carbide	lb.	.04½- .04¾	.05 - .05½
Calcium chloride, fused, lump	ton	22.00 - 23.00	23.50 - 27.00
Calcium chloride, granulated	lb.	.01½- .01¾	.02 .02¼
Calcium peroxide	lb.	-	1.40 - 1.50
Calcium phosphate, tribasic	lb.	-	.15 - .16
Camphor	lb.	-	.93 - .95
Carbon bisulphide	lb.	.06¾- .07	.07½- .07½
Carbon tetrachloride, drums	lb.	.10 - .10½	.10½- .12
Carbonyl chloride, (phosgene)	lb.	-	.60 - .75
Caustic potash (see potassium hydroxide)		-	-
Caustic soda (see sodium hydroxide)		-	-
Chalk, precip.—domestic, light	lb.	.04½- .04½	-
Chalk, precip.—domestic, heavy	lb.	.03½- .03¾	-
Chalk, precip.—imported, light	lb.	.04½- .05	-
Chlorine, gas, liquid-cylinders (100 lb.)	lb.	.05¼- .06	.06¼- .06½
Chloroform	lb.	-	.35 - .38
Cobalt oxide	lb.	-	2.10 - 2.40
Copperas	ton	25.00 - 27.00	27.50 - 30.00
Copper carbonate, green precipitate	lb.	.20 - .20½	.21 - .22
Copper cyanide	lb.	-	.50 - .55
Copper sulphate, crystals	100 lb.	5.75 - 6.00	6.10 - 6.50
Cream of tartar	lb.	-	.25½- .26
Epsom salt (see magnesium sulphate)		-	-
Ether, U.S.P. 100 drums	lb.	-	.13 - .14
Ethyl acetate com. 85%	gal.	-	.72 - .75
Ethyl acetate, pure (acetic ether, 98% to 100%)	gal.	-	.90 - .95
Formaldehyde, 40 per cent	lb.	.14¼- .14½	.14¾- .15
Fullers earth, f.o.b. mines	net ton	16.00 - 17.00	-
Fullers earth—imported powdered	net ton	30.00 - 32.00	-
Fuse oil, ref.	gal.	-	3.00 - 3.50
Fusel oil, crude	gal.	-	2 00 - 2.25
Glauber's salt (see sodium sulphate)		-	-
Glycerine, c.p. drums extra	lb.	-	.18½- .18¾
Iodine, resublimed	lb.	-	4.50 - 4.60
Iron oxide, red	lb.	-	.12 - .18
Lead acetate, white crystals	lb.	-	.12 - .12½
Lead arsenate, powd.	lb.	.14 - .14¼	.4½- .15
Lead nitrate	lb.	-	.18 - .22
Litharge	lb.	.09¼- .09½	.09¾- .10
Magnesium carbonate, technical	lb.	.07 - .07½	.07½- .08
Magnesium sulphate, U.S.P.	100 lb.	2.50 - 2.65	2.70 - 3.50
Magnesium sulphate, technical	100 lb.	-	1.20 - 1.85
Methanol, 95%	gal.	-	1.00 - 1.07
Methanol, 97%	gal.	-	1.03 - 1.10
Nickel salt, double	lb.	-	$0.10 -$0.10½
Nickel salt, single	lb.	-	.11 - .11½
Phogene (see carbonyl chloride)		-	-
Phosphorus, red	lb.	-	.35 - .40
Phosphorus, yellow	lb.	-	.30 - .35½
Potassium bichromate	lb.	$0.09¾- .10	.10¼- .10½
Potassium bromide, granular	lb.	-	.17 - .23
Potassium carbonate, U. S. P.	lb.	.10 - .10½	.11 - .15
Potassium carbonate, 80-85%	lb.	.06 - .06¼	.06½- .06¾
Potassium chlorate, powdered and crystals	lb.	.07¾- .08	.08½- .09
Potassium cyanide	lb.	-	.50 - .53
Potassium hydroxide (caustic potash)	100 lb.	6.50 - 6.60	6.65 - 7.00
Potassium iodide	lb.	-	3.55 - 3.65
Potassium nitrate	lb.	.06½- .06¾	.07 - .08
Potassium permanganate	lb.	.16 - .16½	.16¾- .17
Potassium prussiate, red	lb.	-	.93 - .95
Potassium prussiate, yellow	lb.	.39 - .39½	.39¾- .40
Rochelle salts (see sodium potas. tartrate)		-	-
Salammoniac, white, granular	lb.	.06½- .06¾	.07 - .07½
Salammoniac, gray, granular	lb.	.08 - .08¼	.08½- .08¾
Salsoda	100 lb.	1.20 - 1.40	1.45 - 1.60
Salt cake (bulk)	ton	25.00 -27.00	-
Soda ash, light, 58 per cent flat, bags, contract	100 lb.	1.60 - 1.67	2.00 - 2.25
Soda ash, light, 58 per cent flat, bags, resale	100 lb.	1.75 - 1.80	1.85 - 2.35
Soda ash, dense, in bags, resale	100 lb.	1.85 - 1.90	1.95 - 2.40
Sodium acetate	lb.	.07½- .07¾	.08 - .08¼
Sodium bicarbonate	100 lb.	1.75 - 1.85	1.90 - 2.30
Sodium bichromate	lb.	.07½- .07¾	.08 - .08¼
Sodium bisulphate (nitre cake)	ton	4.50 - 4.60	4.65 - 5.50
Sodium bisulphite powdered, U.S.P.	lb.	.04¼- .04½	.04¾- .05¼
Sodium chlorate	lb.	.06¾- .07	.07¼- .07½
Sodium chloride	long ton	12.00 -13.00	-
Sodium cyanide	lb.	.19½- .21	.21½- .25
Sodium fluoride	lb.	.09¼- .09½	.09¾- .10
Sodium hydroxide (caustic soda) solid, 76 per cent flat, drums, contract	100 lb.	3.35 - 3.40	3.75 - 4.00
Sodium hydroxide (caustic soda) solid, 76% flat, drums, resale	100 lb.	3.50 - 3.60	3.65 - 4.00
Sodium hydroxide (caustic soda), ground and flake, contracts	100 lb.	3.80 - 3.90	4.25 - 4.40
Sodium hydroxide (caustic soda) ground and flake, resale	100 lb.	4.00 - 4.15	4.40 - 4.60
Sodium hyposulphite	lb.	.03 - .03¼	.03½- .04
Sodium nitrite	lb.	.08¾- .09	.09¼- .09½
Sodium peroxide, powdered	lb.	.28 - .30	.31 - .35
Sodium phosphate, dibasic	lb.	.03¾- .04	.04¼- .04½
Sodium potassium tartrate (Rochelle salts)	lb.	-	.18 - .21
Sodium prussiate, yellow	lb.	.20 - .20½	.20¾- .21½
Sodium silicate, (40 deg. in drums)	100 lb.	1.25 - 1.30	1.35 - 1.50
Sodium silicate, (60 deg. in drums)	100 lb.	2.25 - 2.40	2.45 - 2.75
Sodium sulphate, crystals (glaubers salt)	100 lbs.	.85 - .95	1.00 - 1.40
Sodium sulphide, fused, 60-62 per cent (conc.)	lb.	.04½- .04¾	.05 - .05½
Sodium sulphite, crystals	lb.	.03½- .03¾	.03¾- .04¼
Strontium nitrate, powdered	lb.	.09½- .10	.10½- .12
Sulphur chloride, yellow	lb.	.04½- .05	.05¼- .06
Sulphur, crude	ton	18.00 -20.00	-
Sulphur dioxide, liquid, cylinders extra	lb.	.08 - .08½	.09 - .10
Sulphur (sublimed), flour	100 lb.	-	2.50 - 3.15
Sulphur, roll (brimstone)	100 lb.	2.15 - 2.20	2.25 - 2.75
Talc—imported	ton	30.00 -40 00	-
Talc—domestic powdered	ton	18.00 -25.00	-
Tin bichloride	lb.	.10½- .10¾	.11 - .11½
Tin oxide	lb.	-	.43 - .45
Zinc carbonate	lb.	.14 - .14½	.14¾- .15½
Zinc chloride, gran	lb.	.07 - .07½	.07¾- .08
Zinc cyanide	lb.	.42 - .44	.45 - .47
Zinc oxide, XX	lb.	.07½- .08	.08¼- .08½
Zinc sulphate	100 lb.	2.75 - 3.00	3.05 - 3.30

Coal-Tar Products

NOTE—These prices are for original packages in large quantities f.o.b. N.Y.:

Alpha-naphthol, crude	lb.	$0.90 — $0.95
Alpha naphthol, refined	lb.	1.00 — 1.05
Alpha-naphthylamine	lb.	.28 — .30
Aniline oil, drums extra	lb.	.16 — .17
Aniline salts	lb.	.22 — .24
Anthracene, 80% in drums (100 lb.)	lb.	.75 — 1.00
Anthracene, 80%, imported in drums, duty paid	lb.	.65 — .70
Benzaldehyde U.S.P.	lb.	1.25 — 1.35
Benzene, pure, water-white, in drums (100 gal.)	gal.	.30 — .35
Benzene, 90%, in drums (100 gal.)	gal.	.28 — .32
Benzene, 90%, in drums, resale	gal.	.37 — .40
Benzidine, base	lb.	.85 — .90
Benzidine sulphate	lb	.75 — .80
Benzoic acid, U.S.P.	lb.	.72 — .75
Benzoate of soda, U.S.P.	lb.	.57 — .65
Benzyl chloride, 95-97%, refined	lb.	.25 — .27
Benzyl chloride, tech	lb.	.20 — .23
Beta-naphthol benzoate	lb.	3.75 — 4.00
Beta-naphthol, sublimed	lb.	.55 — .60
Beta-naphthol, tech	lb.	.25 — .26
Beta-naphthyla mine, technical	lb.	1.00 — 1.25
Carbazol	lb.	.75 — .90
Cresol, U. S. P., in drums (100 lb.)	lb.	.14 — .20
Ortho-cresol, in drums (100 lb.)	lb.	.18 — .22
Cresylic acid, 97-99%, straw color, in drums	gal.	.60 — .65
Cresylic acid, 95-97%, dark, in drums	gal.	.55 — .58
Cresylic acid, 97%, resale	gal.	.85 — .90
Dichlorbenzene	lb.	.07 — .09
Diethylaniline	lb.	.50 — .60
Dimethylaniline	lb.	.39 — .41
Dinitrobenzene	lb.	.20 — .22
Dinitroclorbenzene	lb.	.22 — .23
Dinitronaphthalene	lb.	.30 — .32
Dinitrophenol	lb.	.32 — .34
Dinitrotoluene	lb.	.22 — .24
Dip oil, 25%, car lots, in drums	gal.	.25 — .30
Diphenylamine	lb.	.54 — .56
H-acid	lb.	.75 — .80
Meta-phenylenediamine	lb.	.90 — 1.00
Monochlorbenzene	lb.	.08 — .10
Monoethylaniline	lb.	.95 — 1.10
Naphthalene crushed, in bbls.	lb.	.06 — .06
Naphthalene, flake	lb.	.06 — .06

Naphthalene, balls	lb.	$0.07 —	$0.07
Naphthionate of soda	lb.	.58 —	.65
Naphthionic acid, crude	lb.	.65 —	.70
Nitrobenzene	lb.	.10 —	.12
Nitro-naphthalene	lb.	.30 —	.35
Nitro-toluene	lb.	.15 —	.17
N-W acid	lb.	1.20 —	1.30
Ortho-amidophenol	lb.	2.25 —	2.30
Ortho-dichlor-benzene	lb.	.17 —	.20
Ortho-nitro-phenol	lb.	.85 —	.90
Ortho-nitro-toluene	lb.	.10 —	.12
Ortho-toluidine	lb.	.12 —	.14
Para-amidophenol, base	lb.	1.20 —	1.25
Para-amidophenol, HCl	lb.	1.25 —	1.30
Para-dichlorbenzene	lb.	.17 —	.20
Paranitroaniline	lb.	.72 —	.80
Para-nitrotoluene	lb.	.55 —	.65
Para-phenylenediamine	lb.	1.50 —	1.55
Para-toluidine	lb.	.85 —	.90½
Phthalic anhydride	lb.	.37 —	.50
Phenol, U. S. P., drums	lb.	.34 —	.35
Pyridine, domestic	gal.	1.60 —	1.75
Pyridine, imported	gal.	1.40 —	1.60
Resorcinol, technical	lb.	1.50 —	1.55
Resorcinol, pure	lb.	2.00 —	2.10
R-salt	lb.	.55 —	.60
Salicylic acid, tech., in bbls	lb.	.35 —	.37
Salicylic acid, U. S. P.	lb.	.40 —	.42
Solvent naphtha, water-white, in drums, 100 gal	gal.	.37 —	.40
Solvent naphtha, crude, heavy, in drums, 100 gal	gal.	.20 —	.23
Sulphanilic acid, crude	lb.	.24 —	.26
Tolidine	lb.	1.20 —	1.30
Toluidine, mixed	lb.	.30 —	.35
Toluene, in tank cars	gal.	.35 —	.37
Toluene, in drums	gal.	.40 —	.43
Xylidines, drums, 100 gal	lb.	.40 —	.45
Xylene, pure, in drums	gal.	.45 —	.50
Xylene, pure, in tank cars	gal.	.45 —	....
Xylene, commercial, in drums, 100 gal	gal.	.40 —	.42
Xylene, commercial, in tank cars	gal.	.30 —	....

Waxes

Prices based on original packages in large quantities f.o.b. N.Y.

Bayberry Wax	lb.	$0.28 —	$0.30
Beeswax, refined, dark	lb.	.30 —	.32
Beeswax, refined, light	lb.	.34 —	.35
Beeswax, pure white	lb.	.39 —	.40
Candelilla, wax	lb.	.34 —	.35
Carnauba, No. 1	lb.	.39 —	.40
Carnauba No. 2, North Country	lb.	.23 —	.24
Carnauba, No. 3, North Country	lb.	.17½—	.18
Japan	lb.	.15 —	.15½
Montan, crude	lb.	.03½—	.04
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb.	.04 —	.04¼
Paraffine waxes, crude, scale 124-126 m.p.	lb.	.02½—	.02¾
Paraffine waxes, refined, 118-120 m.p.	lb.	.03¼—	.03½
Paraffine waxes, refined, 125 m.p.	lb.	.03¼—	.03½
Paraffine waxes, refined, 128-130 m.p.	lb.	.04 —	.04¼
Paraffine waxes, refined, 133-135 m.p.	lb.	.04½—	.04¾
Paraffine waxes, refined, 135-137 m.p.	lb.	.05 —	.05¼
Stearic acid, single pressed	lb.	.09 —	.09¼
Stearic acid, double pressed	lb.	.09½—	.09¾
Stearic acid, triple pressed	lb.	.10 —	.10½

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Rosin B-D, bbl	280 lb.	$6.25 —	....
Rosin E-I	280 lb.	6.35 —	.....
Rosin K-N	280 lb.	6.45 —	$7.00
Rosin W. G.-W. W	280 lb.	7.75 —	8.25
Wood rosin, bbl	280 lb.	6.25 —	.....
Spirits of turpentine	gal.	1.40 —	1.42
Wood turpentine, steam dist	gal.	1.35 —	.....
Wood turpentine, dest. dist	gal.	1.25 —	.....
Pine tar pitch, bbl	200 lb.	...... —	6.00
Tar, kiln burned, bbl. (500 lb.)	bbl.	...... —	12.50
Retort tar, bbl	500 lb.	...... —	11.00
Rosin oil, first run	gal.	.43 —	.....
Rosin oil, second run	gal.	.51 —	.....
Rosin oil, third run	gal.	.53 —	.....
Pine oil, steam dist., sp.gr., 0.930-0.940	gal.		.90
Pine oil, pure, dest. dist	gal.		.85
Pine tar oil, ref., sp.gr. 1.025-1.035	gal.		.46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.		.35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal.		.75
Pine tar, ref., thin, sp.gr., 1.080-1.960	gal.		.25
Hardwood oil, f.o.b. Mich., sp.gr., 0.960-0.990	gal.		.25
Pinewood creosote, ref	gal.		.52

Fertilizers

All prices remain same as previous report.

Crude Rubber

Para—Upriver fine	lb.	$0.25 —	.25½
Upriver coarse	lb.	.17½—	.17¾
Upriver caucho ball	lb.	.20½—	.20¾
Plantation—First latex crepe	lb.	.27½—	.27¾
Ribbed smoked sheets	lb.	.27¼—	.27½
Brown crepe, thin, clean	lb.	.23 —	.23½
Amber crepe No. 1	lb.	.23 —	.23½

Oils

VEGETABLE

The following prices are f.o.b. New York for carload lots.

Castor oil, No. 3, in bbls	lb.	$0.12 —	$0.12½
Castor oil, AA, in bbls	lb.	.12½ —	.13
China wood oil, in bbls	lb.	.12¼ —	.12½
Coconut oil, Ceylon grade, in bbls	lb.	.08¾ —	.08¾
Coconut oil, Cochin grade, in bbls	lb.	.09 —	.09¼
Corn oil, crude, in bbls	lb.	.10¼ —	.10½
Cottonseed oil, crude (f. o. b. mill)	lb.	.08½ —	....
Cottonseed oil, summer yellow	lb.	.10 —	.10½
Cottonseed oil, winter yellow	lb.	.11 —	.11½
Linseed oil, raw, car lots (domestic) bbls	gal.	.85 —	.86
Linseed oil, raw, tank cars (domestic)	gal.	.81 —	.82
Linseed oil, boiled, in 5-bbl lots (domestic)	gal.	.87 —	.89
Olive oil, denatured	gal.	1.12 —	1.15
Palm, Lagos	lb.	.07½ —	.07¾
Palm, Niger	lb.	.07 —	.07¼
Peanut oil, crude, tank cars (f.o.b. mill)	lb.	.11 —	.11½
Peanut oil, refined, in bbls	lb.	.13½ —	.14
Rapeseed oil, refined in bbls	gal.	.78 —	.79
Rapeseed oil, blown, in bbls	gal.	.84 —	.85
Soya bean oil (Manchurian), in bbls. N. Y.	lb.	.11½ —	....
Soya bean oil, tank cars, f.o.b., Pacific coast	lb.	.09¼ —	.09½

FISH

Light pressed menhaden	gal.	$0.54 —	....
White bleached menhaden	gal.	.58 —	.59
Blown menhaden	gal.	.64 —	.65
Whale Oil, No. 1, crude, tanks, coast	gal.	.45 —	.48

Miscellaneous Materials

Shellac, orange fine	lb.	.76 —	.77
Shellac, orange superfine	lb.	.78 —	.79
Shellac, A. C. garnet	lb.	.77 —	.78
Shellac, T. N.	lb.	.74 —	.75

Ferro-Alloys

Ferrotitanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	$200.00 —	$225.00
Ferrochromium, per lb. of Cr contained, 6-8% carbon, carlots	lb.	.11 —	.11½
Ferrochromium, per lb. of Cr contained, 4-6% carbon, carlots	lb.	.11½—	.12
Ferromanganese, 78-82% Mn, Atlantic seaboard duty paid	gross ton	100.00 —	105.00
Spiegeleisen, 19-21% Mn	gross ton	36.00 —	37.00
Ferromolybdenum, 50-60% Mo, per lb. of Mo	lb.	2.00 —	2.25
Ferrosilicon, 10-15%	gross ton	38.00 —	40.00
Ferrosilicon, 50%	gross ton	75.00 —	80.00
Ferrosilicon 75%	gross ton	115.00 —	120.00
Ferrotungsten, 70-80%, per lb. of contained W	lb.	.90 —	.95
Ferro-uranium, 35-50% of U, per lb. of U content	lb.	6.00 —	......
Ferrovanadium, 30-40% per lb. of contained V.	lb.	3.50 —	4.00

Ores and Semi-finished Products

All f.o.b. New York Unless Otherwise Stated

Bauxite, domestic, crushed and dried, f.o.b. shipping points	net ton	$6.00 —	$9.00
Chrome ore, Calif. concentrates, 50% min. Cr_2O_3	ton	22.00 —	23.00
Chrome ore, 50% Cr_2O_3, c.i.f. Atlantic seaboard	ton	18.50 —	19.00
Coke, foundry, f.o.b. ovens	net ton	7.50 —	8.00
Coke, furnace, f.o.b. ovens	net ton	7.00 —	7.25
Fluorspar, gravel, f.o.b. mines, New Mexico	net ton	17.50 —	.....
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mines	net ton	21.50 —	22.00
Ilmenite, 52% TiO_2, per lb. ore	lb.	.01½—	.01½
Manganese ore, 50% Mn, c.i.f. Atlantic seaport	unit	.45 —	......
Manganese ore, chemical (MnO_2)	net ton	75.00 —	80.00
Molybdenite, 85% MoS_2, per lb. of MoS_2, N. Y.	lb.	.80 —	.85
Monazite, per unit of ThO_2, c.i.f., Atlantic seaport	lb.	.06 —	.08
Pyrites, Spanish, fines, c.i.f., Atlantic seaport	unit	.11½—	.12
Pyrites, Spanish, furnace size, c.i.f. Atlantic seaport	unit	.11½—	.12
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	Nominal	
Rutile, 95% TiO_2 per lb. ore	lb.	.12 —	.....
Tungsten, scheelite, 60% WO_3 and over, per unit of WO_3 (nominal)	unit	8.50 —	8.75
Tungsten, wolframite, 60% WO_3 and over, per unit of WO_3, N. Y. C.	unit	7.50 —	8.00
Uranium ore (carnotite) per lb. of U_3O_8	lb.	3.50 —	3.75
Uranium oxide, 96% per lb. contained U_3O_8	lb.	2.25 —	2.50
Vanadium pentoxide, 99%	lb.	12.00 —	14.00
Vanadium ore, per lb. of V_2O_5 contained	lb.	1.00 —	.....
Zircon, washed, iron free, f.o.b. Pablo, Florida	lb.	.04½—	.13½

Non-Ferrous Metals

All f.o.b. New York Unless Otherwise Stated

	Cents per Lb
Copper, electrolytic	13.90
Aluminum, 98 to 99 per cent	22.00 23.00
Antimony, wholesale lots, Chinese and Japanese	6.45
Nickel, ordinary (ingot)	36.00
Nickel, electrolytic	39.00
Nickel, electrolytic, resale	32.00-33.00
Nickel, ingot and shot, resale	36.00
Monel metal, shot and blocks	32.00
Monel metal, ingots	35.00
Monel metal, sheet bars	38.00
Tin, 5-ton lots, Straits	37.00
Lead, New York, spot	7.10
Lead, E. St. Louis, spot	6.95
Zinc, spot, New York	7.50-7.55
Zinc, spot, E. St. Louis	7.15-7.20

OTHER METALS

Silver (commercial)	oz.	$0.65½
Cadmium	lb.	1.15
Bismuth (500 lb. lots)	lb.	2.45
Cobalt	lb.	3.00@3.25
Magnesium, ingots, 99 per cent	lb.	1.00@1.05
Platinum	oz.	$108.00
Iridium	oz.	240.00@275.00
Palladium	oz.	60.00
Mercury	75 lb.	71.00

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

LOS ANGELES—The Comet Oil Co., recently organized with a capital of $600,000, has acquired property on East 26th St., near Downey Rd., as a site for a new oil-refining plant with initial capacity of about 2,500 bbl. It is estimated to cost in excess of $500,000. J. J. Gans, Michael Gore and Adolph Ramish head the company.

SAN DIEGO—The Shell Oil Co., 343 Sansome St., San Francisco, is arranging for the purchase of property on the tidelands for the erection of a new oil storage and distributing plant, to consist of two 25,000-gal. capacity tanks, pumping plant, pipe lines, etc. The company is also preparing to commence work on a similar plant on Front St., Ventura, with initial storage and distributing facilities for 75,000 gal.

SAN FRANCISCO—The De Boom Paint Co., 561 Clay St., has awarded a contract to James Furlong, Monadnock Bldg., for the erection of a new 2-story building on Commercial St., to cost approximately $20,000.

Connecticut

DANBURY—The Transloid Products Co., recently organized, has acquired the factory of the Warner Brothers Co., on East Liberty St., for the establishment of a new plant for the manufacture of composition products, known as Transloid. Machinery will be installed at once and operations placed under way. Charles Hetzel is president and general manager.

Florida

TAMPA—The Imperial Oil Co., 6006 Branch Ave., has awarded a general contract to William Kohler, 33rd St. and 14th Ave., for the erection of the initial buildings for its proposed new local plant for the production of lubricating oils. A list of machinery to be installed is being arranged, to include agitators, oil-blending apparatus, pumping equipment, tanks, etc., providing for a capacity of 500 gal. per day. W. F. Miller is president, and A. M. Allen, general manager.

BRADENTOWN—The local Board of Trade is perfecting plans for the construction of an artificial gas plant for service in this section. It is proposed to organize a company to operate the property, which is expected to be headed by C. N. Turner, proprietor of the Braden Hotel.

Idaho

NAMPA—The Board of Directors of the local Chamber of Commerce is considering plans for the establishment of a new starch-manufacturing plant, to cost about $40,000, with initial equipment. It is purposed to organize a company to operate the factory.

Illinois

CHICAGO—G. K. Nikolas & Co., 1227 West Van Buren St., manufacturers of lacquers, etc., are taking bids for the construction of a 3-story and basement plant addition, 50x70 ft., estimated to cost approximately $50,000. Meyer & Cook, 30 North Dearborn St., are architects.

Louisiana

NEW ORLEANS—The Union Carbide Co., 30 East 42nd St., New York, has perfected plans for plant additions for its subsidiaries, the Prest-O-Lite Co. and the Linde Air Products Co. The first noted will soon break ground for the erection of a large acetylene plant on site acquired some time ago on Upperline St., fronting on the 17th St. canal, estimated to cost in excess of $200,000. The Linde company, manufacturer of industrial oxygen, etc., has work under way on a new plant at St. Louis and North Anthony Sts., to cost more than $300,000. It is expected to have the latter works ready for the machinery installation early in the coming year.

Maryland

BALTIMORE—The Air Reduction Co., 342 Madison Ave., New York, will take bids at once for the erection of its proposed new local plant on Fayette St., near 11th St., for the manufacture of industrial oxygen, oxy-acetylene apparatus, etc., estimated to cost about $150,000, of which amount more than $85,000 will be used for equipment. Francisco & Jacobus, 511 5th Ave., New York, are consulting engineers.

Massachusetts

EAST WALPOLE—Bird & Son, Inc., 185 Devonshire St., Boston, manufacturer of prepared roofing, paper products, etc., has plans in progress for the construction of a new plant addition. Monks & Johnson, 99 Chauncey St., Boston, are architects.

FALL RIVER—The Standard Oil Co., foot of Slade St., has commenced the erection of a new distributing plant to cost about $37,000.

Michigan

SAULTE STE. MARIE—The Union Carbide Co., 30 East 42nd St., New York, will soon commence the erection of an addition to its local plant for considerable increase in capacity, to include a number of improvements in the present works, designed to give employment to an additional working force of about 300 operatives. A new set of kilns will be constructed. The expansion, with equipment, is estimated to cost about $500,000.

PALMYRA—The Simplex Paper Co. has commissioned the Austin Co., 16112 Euclid Ave., Cleveland, O., engineer and contractor, to prepare plans for a new local plant, to include power house, estimated to cost close to $100,000.

PETOSKEY—The Petoskey Portland Cement Co. is planning for the rebuilding of the portion of its plant, including laboratory, machine shop and other structures, destroyed by fire, Nov. 19, with loss of about $50,000. The work will be carried out in connection with the proposed new plant additions, estimated to cost close to $500,000.

MARYSVILLE—The Athol Mfg. Co., manufacturer of rubberized products, is planning for enlargements in its plant, to include the installation of additional equipment. It is purposed to add to the present line of production.

MONROE—The Consolidated Paper Co., East Elm St., has preliminary plans under way for the construction of a new mill for the production of strawboard and kindred specialties. W. C. Tullis is secretary.

PONTIAC—The Wilson Foundry & Machine Co. will commence the immediate erection of a new 1-story addition, 36x50 ft., to be equipped as a testing laboratory.

DETROIT—The Huron Portland Cement Co., Ford Bldg., has preliminary plans under way for the rebuilding of its local distributing plant at Atwater and Riopelle Sts., recently destroyed by fire. The new structure is estimated to cost in excess of $100,000. J. W. Boardman is vice-president.

New Jersey

KEARNY—The Egyptian Lacquer Co., Passaic Ave., has awarded a contract to the United Fireproofing Co., 8 West 40th St., New York, for the erection of a 3-story plant addition to cost about $37,000. Work will be placed under way at once.

ELIZABETH—The T. G. & M. Chemical Co., 517 Cortland St., Belleville, N. J., has leased the former factory of the Loewenstein Radio Co., on Meadow Lane, for the establishment of a new plant. Improvements will be made in the building and equipment installed at an early date. It is planned to remove the present works to the new location.

JERSEY CITY—Work will be placed under way at once on a new 1-story foundry at the plant of the M. W. Kellogg Co., Hackensack Ave., manufacturer of pipe, pipe bends, etc., estimated to cost $50,000.

NEWARK—The Blackstone Mfg. Co., 203 Johnston Ave., manufacturer of food colors, etc., has filed plans for the erection of a new 3-story plant at 206-10 Johnston Ave., to cost $25,000.

BAYONNE—The Vacuum Oil Co., 61 Broadway, New York, is taking bids for the erection of a 2-story storage and distributing building at its local refinery, 75x190 ft.

NEWARK—Fire, Nov. 25, destroyed a portion of the leather tannery of Kaufherr & Siegel, Ave. L and Magazine St., with loss estimated at about $45,000, including equipment and stock. It is planned to rebuild at once.

NEWARK—Louis Sacks, Wilson Ave., operating a foundry for the production of gray iron castings, has filed plans for the erection of a 1-story foundry addition, to cost about $13,000.

New York

LONG ISLAND CITY—The Liberty Paint Co., 39 10th St., has filed plans for the immediate erection of a new 2-story plant, 100x100 ft., estimated to cost about $100,000.

NEW YORK—The International Petroleum Co., 120 Broadway, has commenced work on a new oil project in the South American oil fields, comprising a pipe line, pumping plants, distributing and storage plants, and other structures to cost in excess of $15,000,000, with equipment. The company is associated with other oil interests in the enterprise, including the Leonard Oil Development Co., Transcontinental Oil Co., Colombia Syndicate, and affiliations of the Standard Oil Co.

Ohio

CUYAHOGA FALLS—The Common Council is considering tentative plans for the installation of a filtration plant at the city waterworks for the removal of excess iron from the municipal water.

CAMBRIDGE—The plant and property of the Florentine Pottery Co., East Cambridge, owned by the Pfau Mfg. Co., Cincinnati, now in charge of a trustee in bankruptcy, has been purchased by E. S. Romaine, Wheeling, W. Va., for a consideration of $50,000. The new owner is said to be planning to organize a company and operate at the plant.

Oklahoma

OKMULGEE—The Phillips Higrade Refining Co. has plans nearing completion for extensions and improvements in its local oil refinery, to include the installation of new recovery systems, bleacher and run-down tanks, power plant apparatus, and other equipment, estimated to cost close to $500,000. Work will be placed under way at an early date.

OKLAHOMA CITY—The Board of Works has commenced extensions and improvements in the local water system, to include a new filtration plant, estimated to cost in excess of $1,000,000.

TULSA—The Taylor Paper Co., Memphis, Tenn., is planning for the establishment of a new branch plant here to cost approximately $100,000, including equipment.

Pennsylvania

PHILADELPHIA—The United Oxygen Mfg. Co., Westmoreland and B Sts., will break ground at once for the erection of a new 1-story plant, 25x45 ft., on Buckius St., near Richmond Ave. The general building contract has been let to George Tomlinson & Son, 1713 Sansom St., Philadelphia.

PHILADELPHIA—The Kohler Co., Kohler, Wis., manufacturer of sanitary ware and other pottery products, has acquired property at Turner and 32nd Sts., totaling about 15,000 sq.ft., as a site for the erection of a new 3-story branch plant. Plans will be placed under way at once.

PITTSBURGH—The Vitro Mfg. Co., Bessemer Bldg., manufacturer of enamels, dioxide, etc., is completing plans for the erection of a new 1-story plant addition, 32x45 ft., on Oliffe St.

PHILADELPHIA—The Great Eastern Mills Co., 440 7th Ave., Pittsburgh, has leased two buildings at 939-41 North Front St., for the establishment of a new mill for the manufacture of pulverized sugar.

PHILADELPHIA—The Pecora Paint Co., 4th and Sedgley Sts., has filed plans for the erection of a new 1-story building at its plant at 3rd and Sedgley Sts.

BRISTOL—The Megargee Paper Mills, Inc., Modena, Pa., is taking title to a tract of local property, totaling about 70 acres, for a consideration of about $60,000, to be used as a site for a new paper mill. Plans are under way for the initial plant unit, to consist of a number of buildings. It is expected to commence work at an early date.

PHILADELPHIA—The Continental Leather Co., 315 North 3rd St., will commence the immediate erection of a 1-story addition to its tannery at Tacony and Van Kirk

Sts. The general contract has been let to the Truscon Steel Co., 1432 South Penn Sq.

Tennessee

KNOXVILLE — The Knox Porcelain Co., recently organized with a capital of $370,000, to manufacture electrical porcelain products, will break ground at once for a new 3-unit plant, on tract of local property, comprising about 5 acres of land. It will be equipped for a daily production of close to 75,000 small porcelain specialties. J. N. House is president.

COLUMBIA — The Greenway Co., J. B. Greenway, general manager, has acquired a large tract of land on the Culleika Pike, and will use the site for a new plant for the manufacture of automobile tires, estimated to cost about $150,000.

Texas

RANGER—The Straits Oil Co., operating on the Barker property, about 6 miles from Ranger, is planning for extensions in its casinghead gasoline plant to cost about $25,000. The capacity will be considerably increased.

TEXAS CITY—The Marland Oil & Refining Co., Ponca City, Okla., is planning for the purchase of a site in this vicinity, on the waterfront, for the construction of a new storage and distributing plant, estimated to cost in excess of $100,000.

Virginia

BIG ISLAND—The Bedford Pulp & Paper Co., Richmond, has revised plans in preparation for the erection of a 3-story addition to its local paper mill, 60x140 ft., estimated to cost approximately $35,000, exclusive of equipment. The company has recently arranged for a bond issue of $800,000, a portion of the proceeds to be used for general expansion. Milton E. Marcuse is president. Charles K. Bryant, 1808 Hanover Ave., Richmond, is architect for the new mill extension.

STRASBURG — The Hy-Grade Manganese Co., Woodstock, Va., has acquired a building at East Strasburg, for the establishment of a new mill. The structure will be remodeled and improved, and equipment installed, including a grinding mill, power apparatus, etc. J. C. Ackerson is general manager.

NORFOLK—The Fisheries Products Corp. has tentative plans under way for the erection of a 1-story plant, 245x300 ft., at its site at Money Point, for the manufacture of fertilizer products, to replace the portion of the works recently destroyed by fire. The new structure, with equipment, is estimated to cost about $200,000. Headquarters of the company are at 50 Broad St., New York.

BIG STONE GAP—W. W. Taylor is arranging for the organization of a company to construct and operate a local plant for the manufacture of brick and other burned clay products. Daniel Bostic, Big Stone Gap, is also interested in the project.

GLASGOW — The Glasgow Clay Products Co. is planning for the installation of a rotary drier at its plant, with capacity of about 10 tons of shale per hour.

Washington

SEATTLE — In addition to extension and improvement work now in progress at its storage and distributing plant, to cost about $200,000, the Associated Oil Co., 1733 Railroad Ave., has plans in progress for additional work, including steel tanks, etc., estimated to cost about $150,000. A. J. McNeil, 207 White Bldg., is resident engineer for the company.

West Virginia

HALLTOWN—The Halltown Paper Board Co. is planning for the rebuilding of the portion of its plant, including power house, recently destroyed by fire.

FOLLANSBEE — The Jefferson Glass Co., manufacturer of illuminating glassware, is arranging a fund of $150,000, the proceeds to be used for extensions and improvements in its local plant. A portion of the structure will be remodeled and additional equipment installed. C. H. Blumenauer is president.

WARWOOD—The Centre Foundry & Machine Co. has awarded a contract for the immediate erection of a new 1-story foundry at its works, 100x320 ft., to be equipped for the production of gray iron castings. It will have a capacity of about 50 tons per day. F. H. Young is general manager.

Wisconsin

MILWAUKEE—The Pfister & Vogel Leather Co., 443 Virginia St., has awarded a contract to the Dahlman Construction Co., 456 Broadway, for the erection of a 1-story addition to its tannery, 63x63 ft. Work will be commenced at once.

MILWAUKEE—The Palmolive Co., manufacturer of soaps, has work under way on a 1-story addition to its plant, 50x80 ft., to be used for general increase in production. Lockwood, Greene & Co., Chicago, Ill., are engineers.

New Companies

THE KENWOOD WAX PAPER MILLS, INC., 4761 West Hipple Ave., Chicago, Ill., has been incorporated with a capital of $150,000, to manufacture plain and waxed papers. The incorporators are Louis G. Berman, Alfred G. Johnson and Otto C. Bruhlman.

THE STA-BRITE CO., New York, N. Y., care of the Delaware Registration & Incorporating Co., 2 Rector St., New York, representative, has been incorporated under Delaware laws, with a capital of $100,000, to manufacture paints, varnishes, etc. The incorporators are Joseph V. Burns and G. I. Lewis.

THE AUTOMATIC GLASS PRODUCTS Co., Toledo, O., has been incorporated with a capital of $150,000, to manufacture glass specialties. The incorporators are Charles H. Lemmon and M. J. Warner, both of Toledo.

THE AMERICAN DENATURING CORP., New York, N. Y., care of Wallace & Thatcher, Albany, N. Y., representatives, has been incorporated with a capital of $50,000, to manufacture industrial alcohol and kindred products. The incorporators are L. H. Washburn, K. M. Smith and T. J. Mattimore, New York.

THE RAYNAUD-CONRAD PAINT CO., New Orleans, La., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws, with a capital of $1,100,000, to manufacture paints, varnishes, oils, etc. The incorporators are Joseph Raynaud, C. Carlisle Conrad and George Steele, all of New Orleans.

THE WILLIAM J. SWEET FOUNDRY Co., Bayonne, N. J., has been incorporated with a capital of $15,000, to manufacture iron, steel and other metal castings. The incorporators are William J. Sweet, Charles V. Bruno and Harry A. Cooper, 12 East 34th St., Bayonne. The last noted represents the company.

THE SHERATONE PRODUCTS CORP., New York, N. Y., care of G. W. Phillips, 295 West 144th St., New York, representative, has been incorporated with a capital of $50,000, to manufacture polishes, chemical preparations, etc. The incorporators are W. H. Naugle and W. K. Rishel.

THE WEST COAST CHEMICAL CORP., San Francisco, Calif., has been incorporated with a capital of $300,000, to manufacture chemicals and chemical byproducts. The incorporators are P. E. and Henry P. Adams, Homer Lingenfelter and Clarence E. Todd, Hobart Bldg., San Francisco. The last noted represents the company.

THE BLUE RIDGE OXIDE Co., Allentown, Pa., has been incorporated with a capital of $30,000, to manufacture oxides, chemical products, etc. H. S. Hartzell, Allentown, is treasurer and representative.

THE LIBERTY MIRROR WORKS, INC., Pittsburgh, Pa., is being organized under state laws, to manufacture mirrors, glass novelties, etc. Application for a state charter will be made on Dec. 22. The company is headed by George F. and William H. Colbert, and Benjamin H. Thompson, 1209 First National Bank Bldg., Pittsburgh. The last noted represents the company.

THE LUFBERRY Co., INC., Bayonne, N. J., has been incorporated with a capital of $100,000, to manufacture chemicals and chemical byproducts. The incorporators are A. D. Harz, Burgess A. and Percival G. Cruden, 1 West 8th St., Bayonne. The last noted represents the company.

THE NATIONAL CONSUMERS' PAPER CORP., New York, N. Y., care of Horowitz, Riedler & Hurwitz, 1170 Broadway, New York, representatives, has been incorporated with a capital of $200,000, to manufacture paper products. The incorporators are H. and B. Kuskel, and H. L. Rosenberg.

THE WELCH JAPANNING Co., Woburn, Mass., has been incorporated with a capital of $10,000, to manufacture japanned metal products. George C. Dempsey, 133 Commonwealth Ave., Boston, is treasurer and representative; William C. Welch is president.

THE E. E. DICKINSON Co., Essex, Conn., has been incorporated with a capital of $750,000, to manufacture essential oils, extracts, etc. The incorporators are Edward E. and Edward E. Dickson, Jr., and Carl F. Anderson, all of Essex.

THE CHLOROPHEN CHEMICAL Co., Elkins, W. Va., has been incorporated with a capital of $25,000, to manufacture chemicals and chemical byproducts. The incorporators are C. L. Stuckey, F. A. Ravenscraft and F. S. Johnson, all of Elkins.

THE ILLINOIS PRODUCTS Co., 1850 West North Ave., Chicago, Ill., has been organized under state laws to manufacture chemicals and kindred products. The incorporators are Frank P. Lyons and Louis Lowy.

THE POLO OIL Co., care of the Corporation Trust Co. of America, du Pont Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with a capital of $100,000, to manufacture petroleum products.

THE HAGERSTOWN LIME & CHEMICAL Co., Hagerstown, Md., has been incorporated with a capital of $30,000, to manufacture chemicals, lime and affiliated products. The incorporators are Jacob S. Myers, Enos L. Kitzmiller and William R. Moler, all of Hagerstown.

THE RUSTOFF Co., Brooklyn, N. Y., care of Bick, Godnick & Freedman, 215 Montague St., Brooklyn, representatives, has been incorporated with a capital of $100,000, to manufacture chemicals and affiliated products. The incorporators are W. Godnick, J. A. Freedman and R. Mendel.

THE REPUBLIC PAPER PRODUCTS Co., Richmond, Va., has been incorporated with a capital of $100,000, to manufacture paper specialties. A. H. Cohen is president and I. W. Cohen, secretary.

THE REED SMITH CHEMICAL Co., Camden, N. J., care of the Corporation Trust Co., 328 Market St., Camden, representative, has been incorporated with a capital of 1,000 shares of stock, no par value, to manufacture chemicals and chemical byproducts.

THE PENN PROCESS Co., INC., Philadelphia, Pa., care of Albert W. Sanson, Bailey Bldg., Philadelphia, representative, is being organized to manufacture chemicals, chemical solutions and kindred products. The company is headed by Charles W. Beck, Sr. and Jr., and Horace D. Beck.

THE FOSTER PETROLEUM PRODUCTS Co., Jamestown, N. Y., care of A. C. Nelson, Jamestown, representative, has been incorporated with a capital of $25,000, to manufacture oil specialties. The incorporators are E. S. Nelson and C. S. and A. C. Foster.

THE KEENAN PETROLEUM Co., Houston, Tex., has been incorporated with a capital of $100,000, to manufacture petroleum products. The incorporators are L. W. Keenan, C. W. Drury and R. K. Howell, all of Houston.

THE BRANFORD BROTHERS FOUNDRY, INC., Branford, Conn., has been organized under state laws to manufacture iron, steel and other metal castings. H. A. Cox is president; and Robert L. Rosenthal, treasurer, both of Branford.

THE MERIDEN INDUSTRIAL ALCOHOLS, INC., Newark, N. J., has been incorporated with a capital of $10,000, to manufacture denatured alcohol and kindred specialties. The incorporators are Jeffrey J. Lewis, Leo Roon and Morris Reiser, 321 Washington St., Newark. The last noted represents the company.

THE AMERICAN EFFECTION CORP., care of the Delaware Registration Trust Co., 900 Market St., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $500,000, to manufacture chemicals and chemical byproducts.

THE IRVINGTON ALUMINUM FOUNDRY & STOVE WORKS, INC., Irvington (Alameda County), Cal., has been incorporated with a capital of $100,000, to manufacture aluminum, iron and other metal castings. The incorporators are Thomas Tierney, P. C. Hanson and Frank A. Leal. The company is represented by E. M. Grimmer, Irvington.

THE BLAISDELL PETROLEUM PROCESS & REFINING Co., Portland, Me., has been incorporated with a capital of $200,000, to manufacture petroleum products. L. T. Garniss is president; George W. Garniss, treasurer. The company is represented by Charles J. Nichols, Portland.

THE HOUSTON OIL Co., Houston, Tex., care of the Colonial Charter Co., Ford Bldg., Wilmington, Del., representative, has been incorporated under Delaware laws with capital of $3,000,000, to manufacture petroleum products. The incorporators are Walter F. Brown, Joseph F. Meyer, Jr., and John A. Deering, Houston.

THE HAGIN TURPENTINE Co., Lyman, Miss., has been organized under state laws to produce turpentine and kindred products. The incorporators are E. Hagin and F. R. White, both of Lyman.

Industrial Developments

GLASS — The Scott-Warman Glass Co., manufacturer of hollowware, has commenced produced at its new local plant comprising a rebuilding of the factory destroyed by fire a number of months ago. Employment is being given to about 125 men on full turn, with a scheduled output of 2 carloads of bottles per day day. The company is said to have orders on hand to insure this basis of production for a number of months to come.

Owing to a shortage of natural gas, glass plants at Salem, W. Va., have been forced to curtail operations. The Salem Co-operative Window Glass Co. and the Salem Flint Glass Co. have temporarily suspended, with prospects of resuming at an early date.

PAPER—Officials of Sears, Roebuck & Co., Arthington and Homan Aves., Chicago, Ill., have organized the Eddy Paper Co. of Illinois, to take over and operate the mills of the Eddy Paper Co., at Three Rivers and White Pigeon, Mich. The acquisition is said to have resulted from financial difficulties. The new owners plan to resume operations at the mills at an early date, having the plants on a capacity basis in about 60 days.

The Dixie Wax Paper Co., Dallas, Tex., has opened its new plant at 3008 Williams St., on a production basis of 5 tons per day. The mill is said to be the only one of its kind south of Kansas City, Mo. It is expected to maintain full operations for an indefinite period. William H. Bryce is treasurer.

RUBBER—The Interlocking Cord Tire Co., Akron, O., is planning to increase production at its mill at an early date. Additional workers will be employed.

Following the appointment of a receiver for the Perfection Tire & Rubber Co., Fort Madison, Iowa, officials of the company are developing plans for a reorganization, and expect to place the local plant on an operating basis at an early date.

LEATHER—The Armour Leather Co., Chicago, Ill., is running its side leather plant at full capacity, with regular working force, and plans to continue on this basis for an indefinite period.

The American Oak Leather Co., Cincinnati, O., has placed its plant on a basis of about 85 per cent of capacity.

CERAMIC—The Hazleton Brick Co., Hazleton, Pa., is operating on a full production basis at its local plant, and will probably continue on this basis throughout the winter.

Operative potters at Trenton, N. J., out on strike for a number of weeks, have appointed a conference committee to negotiate for a settlement with the local sanitary ware plants. It is said that other local organizations in the different pottery centers will take similar action. A number of the potteries at Trenton have discontinued operations and are installing casting plants to eliminate a considerable number of workers heretofore necessary.

Brick-manufacturing plants in the Chicago, Ill., district, equipped with mechanical drier plants, are continuing operations at full capacity under a heavy demand for material. It is expected to continue without interruption for a number of months to come.

IRON AND STEEL—The Inland Steel Co., Chicago, Ill., has 3 blast furnaces in operation, and is running 15 out of 18 sheet mills.

The Scottdale Furnace, Scottdale, Pa., has been placed in blast following a shut-down of more than 2 years. The furnace has a capacity of 350 tons of pig iron per day, and will give employment to a working force of 250 men.

The Michigan Steel Corp., 1706 First National Bank Bldg., Detroit, Mich., recently organized with a capital of $1,000,000, is perfecting plans for the construction of a new mill on site comprising about 35 acres of land between Oakwood and Ecorse, Mich., lately acquired. The initial works will comprise six units, with power plant and other mechanical buildings, and is estimated to cost in excess of $600,000. It is expected to be ready for service in the fall of 1923, and will give employment to about 400 men. Initial production will be devoted to sheet steel for automobile and other important lines of manufacture. Frederick R. Lovejoy is chairman of the board; George R. Fink, formerly connected with the West Penn Steel Co., is president and treasurer; and Frank R. Jones, vice-president.

The Trumbull-Cliffs Iron Co., Youngstown, O., a subsidiary of the Trumbull Steel Co., is developing record production at its 600-ton blast furnace, which has now been completed and in service for about a year. Recently, in a 24-hour period, the stack produced 867 tons of pig iron, and in a 30-day turn manufactured 22,500 tons.

The Tennessee Coal, Iron & Railroad Co., Birmingham, Ala., has blown in its No. 5 furnace at Ensley, Ala., making six stacks in production at this place. Three of the furnaces are on foundry iron, the others on basic, while the Alice furnace is producing steel-making iron.

The National Enameling & Stamping Co., Granite City, Ill., expects to have its new sheet mill, now in course of construction, ready for service some time during next July. The mill will represent an investment of close to $1,500,000, and will give employment to a large increased working force at the plant.

The Cambria Steel Co., Johnstown, Pa., has been making a number of improvements at its limestone quarries at Naginey, Pa., preparatory to increasing production. Five large steam shovels will be used for rock digging, replacing man-labor. A daily output of 28 carloads of graded limestone will be produced for use at the Johnstown steel mills. The working force will be increased in a number of departments, bringing the quota to about 200 men.

The Shelby Iron Co., Shelby, Ala., has its blast furnace out for repairs, and is making ready to blow in the stack shortly after the first of the year.

COKE—The Semet-Solvay Co., Syracuse, N. Y., has arranged for an immediate increase in production at its Riverside coke plant from 250 to 400 tons per day, to accommodate the increased demand from the local works of the National Tube Co.

The Alabama By-Products Co., Birmingham, Ala., is making ready to place its new battery of 25 coke ovens in service, giving the plant a total of 75 ovens, devoted to high-grade foundry and gas house coke.

MISCELLANEOUS — The Champion Spark Plug Co., Toledo, O., manufacturer of porcelain spark plugs, is arranging for a heavy increase in production at its plant during 1923.

Paint manufacturers in the vicinity of Cleveland, O., are operating on a full capacity, full time basis, as compared with a usual decline in this same season in other years. Paint and varnish producers at Philadelphia, Pa., are also on a capacity schedule.

The Standard Chemical Co., Denver, Colo., is discontinuing production at its Carnotite properties, Paradox Valley district, Montrose County, for an indefinite period. About 250 men will be released from the works.

The Marland Oil Co., operating in the Mid-continent field, Oklahoma, has advanced production to a basis of 18,000 bbl. of crude oil per day.

The Texas Sulphur Co., Orange, Tex., is being reorganized and plans to resume operations at its properties at an early date at close to capacity basis. Charles F. Suderman is president.

Manufacturers' Catalogs

THE COMBUSTION ENGINEERING CORP., New York, has issued two new pieces of literature. The larger bulletin, on the Coxe stoker, covers particularly the performance of this stoker on Western and mid-Western bituminous coals. A number of test reports, each accompanied by corresponding curves, are included. These tests show very remarkable results and because they are complete in every respect they will be of considerable interest to the engineering world. Three years ago it was thought impossible to burn bituminous coal on Coxe stokers or any forced draft traveling grate stokers. Today we have a number of successful installations in some of the biggest and most important plants in the Middle West. Pictures of a number of them are shown in this bulletin. The smaller bulletin, the "Service Bulletin," while it is issued by this company, will be of value to all stoker companies. At the present time it is necessary for stoker manufacturers to render, gratuitously, service of a very costly nature. This booklet presents the stoker manufacturers' side of the question and shows why a proper charge for real stoker service would not only be fair to the recipient but would be to his advantage. It is illustrated with an interesting cartoon story.

THE JEFFREY MFG. CO., Columbus, O., in Catalog 257, treats of Standardized Scraper Conveyors. Interesting illustrations and descriptive matter on these conveyors are given.

THE DAYTON-DOWD CO., Quincy, Ill., announces Bulletin 249, which supersedes Bulletin 244 on Centrifugal Pumps.

THE COOPER HEWITT ELECTRIC CO., Hoboken, N. J., has issued pamphlets on "Quartz-Glass Apparatus for Photophysics and Photochemistry," "The Ultra-Violet," "Uviarc Lamps in the Laboratory," "The Lab-Arc," and "The Uviarc Test for Dyes, Inks, Textiles, Leather, Paints and Paper."

H. S. B. W.-COCHRANE CORP., Philadelphia, discusses, in a recent pamphlet, the deaëration of water to prevent corrosion in piping, economizers and boilers. The apparatus described is designed to deliver water free of dissolved oxygen, at any temperature from 140 deg. F. up, as required for hot water heating and service systems and for feeding to economizers and boilers. The method consists in heating the water by spraying in a chamber under vacuum and then vigorously agitating or scrubbing the water by blowing steam through it. The heating of the water to the temperature corresponding to the pressure existing in the vessel renders gases insoluble, while the subsequent reboiling of the water serves to pick up and flush out small gas bubbles which otherwise would not have time to escape from the water. The Cochrane vacuum deaërating heater is designed to be used where the auxiliaries are operated under vacuum or where they are operated under back pressure, also in connection with primary and secondary heaters and as the condenser for a make-up evaporator. The full vacuum corresponding to the temperature to which the water is heated is available to the house turbine or other auxiliaries exhausting to the heater. Charts are given showing the amount of iron converted into rust by water containing different amounts of oxygen, vapor pressures, corresponding to water temperatures and solubilities of oxygen and nitrogen in water at various temperatures and pressures. The Winkler test for detecting dissolved oxygen in water is also described.

Coming Meetings and Events

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE will hold a meeting Dec. 26 to 30 in Boston, Mass.

AMERICAN CERAMIC SOCIETY will hold its annual meeting in Pittsburgh, Pa., Feb. 12 to 17, 1923.

AMERICAN CHEMICAL SOCIETY will hold its spring meeting April 3 to 7, 1923, at New Haven, Conn.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its spring meeting May 3, 4 and 5, 1923, at the Commodore Hotel, New York City.

AMERICAN ENGINEERING COUNCIL, executive organ of the Federated American Engineering Societies, will meet in Washington, D. C., Jan. 11 and 12, 1913.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its annual meeting in New York City during the week of Feb. 19, 1923.

INTERNATIONAL CHAMBER OF COMMERCE will hold its second general meeting in Rome, Italy, March 19-26, 1923.

NEW JERSEY CHEMICAL SOCIETY holds a meeting at Stetters Restaurant, 842 Broad St., Newark, N. J., the second Monday of every month.

SOCIETY OF CHEMICAL INDUSTRY, American Section, will meet in Rumford Hall, 52 East 41st St., New York City, on Dec. 15.

SOCIETY OF INDUSTRIAL ENGINEERS, with headquarters in Chicago, will hold its spring convention in Cincinnati, April 18, 19 and 20, 1923. The major subject will be "Management Problems of the Smaller Plants."

TECHICAL PHOTOGRAPHIC AND MICROSCOPICAL SOCIETY will hold a meeting with the Society of Chemical Industry, Dec. 15, at the Chemists' Club, East 41st St., New York City.

The following meetings are scheduled to be held in Rumford Hall, Chemists' Club, East 41st St., New York City: Jan. 5 — American Chemical Society, regular meeting. Jan. 12—Society of Chemical Industry, Perkin Medal. Feb. 9—American Electrochemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, American Chemical Society, joint meeting. March 9—American Chemical Society, Nichols Medal. March 23—Society of Chemical Industry, regular meeting. April 20—Society of Chemical Industry (in charge), American Electrochemical Society, Société de Chimie Industrielle, American Chemical Society, joint meeting. May 4—American Chemical Society, regular meeting. May 11—Société de Chimie Industrielle (in charge), American Chemical Society, American Electrochemical Society, Society of Chemical Industry, joint meeting. May 18—Society of Chemical Industry, regular meeting. June 8—American Chemical Society, regular meeting.